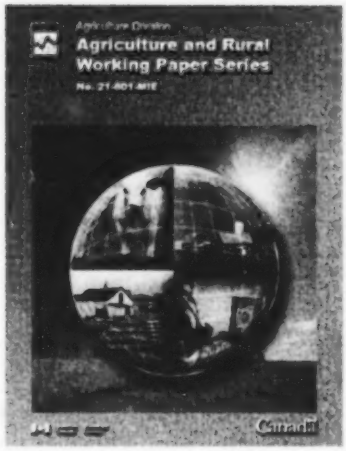
Catalogue no. 21-601-MIE — No. 063
ISSN: 1707-0368
ISBN: 0-662-34054-X

Research Paper

Sub-provincial income disparity in Canada: Evidence from 1992 to 1999



by Alessandro Alasia

Agriculture Division
Jean Talon Building, 12th floor, Ottawa, K1A 0T6

Telephone: 1 800-465-1991

This paper represents the views of the author and does not necessarily reflect the opinions of Statistics Canada.

Statistics Canada Statistique Canada

Canada

106-03239/

Statistics
Canada
Agriculture Division

Agriculture and Rural Working Paper Series
Working Paper No. 63

Sub-provincial income disparity in Canada: Evidence from 1992 to 1999

Prepared by
Alessandro Alasia
Research and Rural Data Section, Agriculture Division

Statistics Canada, Agriculture Division
Jean Talon Building, 12th floor
Tunney's Pasture
Ottawa, Ontario K1A 0T6

April 2003

The responsibility of the analysis and interpretation of the results is that of the author and not of Statistics Canada.

Statistics
Canada
Agriculture Division

Agriculture and Rural Working Paper Series
Working Paper No. 63

Sub-provincial Income Disparity in Canada: Evidence from 1992 to 1999

Published by authority of the Minister responsible for Statistics Canada.

© Minister of Industry, 2003.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise without prior written permission from Licence Services, Marketing Division, Statistics Canada, Ottawa, Ontario, Canada K1A 0T6.

April 2003

Catalogue No. 21-601-MIE
ISSN: 1707-0368
ISBN: 0-662-34054-X

Frequency: Occasional

Ottawa

La version française est disponible sur demande (nº 21-601-MIF au catalogue)

Note of acknowledgement and appreciation: Canada owes the success of its statistical system to a longstanding partnership between Statistics Canada and the citizens, businesses and governments of Canada. Accurate and timely statistical information could not be produced without their continued co-operation and good will.

The author would like to acknowledge the Small Area and Administrative Data Division, Statistics Canada, for providing the data used in this study.

Standards of service to the public

Statistics Canada is committed to serving its clients in a prompt, reliable and courteous manner and in the official language of their choice. To this end, the agency has developed standards of service which its employees observe in serving its clients. To obtain a copy of these service standards, please contact Statistics Canada toll free at 1 800 263-1136.

Executive Summary

The reduction of territorial[1] disparities has become a policy priority for most OECD countries and, from a research perspective, one of the main objectives of territorial analysis is monitoring disparity trends across time. The study of regional income disparities in Canada has been dominated by provincial level analysis and by an econometric approach aimed at testing the convergence hypothesis. However, it has been acknowledged that, in order to generate a better understanding of territorial trends, it is necessary to rely on a comprehensive set of measures that capture the multiplicity and complexity of the underling spatial processes (OECD, 2001).

This paper reviews a broad set of concepts and related measures of territorial disparity that can inform the policy debate. It then applies these measures to the Canadian context, using data on income from income tax returns from 1992 to 1999 for about 280 Census Divisions covering the entire country. This approach allows an assessment of the rural trends in a broader territorial context that includes most of the CDs of Canada. Three dimensions of territorial disparity are considered, which focus in particular on the concepts of convergence, concentration and persistence of disparity. The short period of time considered limits the possibility of separating secular trends from cyclical fluctuations. Therefore, the findings provide relevant insights on the spatial characteristics of growth during the 1990s, but extrapolation to a longer period should be done with care. Despite the first-pass nature of this study in the assessment of sub-provincial disparities, the analysis produced some noteworthy results which are summarized below.

Key Findings

- Between 1992 and 1999, territorial income disparities in Canada increased. The convergence / divergence path that was observed follows closely the national business cycle with divergence associated with the stage of economic expansion of the late 1990s.
- Decomposition of total disparities indicates that the relative importance of income disparity due to between-province disparity decreases over the 1990s, while within-province disparity increases substantially. In other words, the average provincial income is less relevant in explaining the increasing spatial income disparity across Canada.
- In contrast to the previous point, the disparities between CD regional types (rural and urban) become relatively more important. Although the changes are not dramatic, and despite the fact that provincial differences remain sizable, the geography of income

[1] "Territorial development" is the term used by the OECD to draw attention to the fact that economic development has sub-national or local dimensions. In this report, "territorial" refers to Canada's census divisions as sub-provincial units.

disparities shifts slowly but steadily from a provincial to a rural / urban divide during the period of time considered.

- There is an increasing concentration of the national aggregate income in a small number of CDs. After a slight decrease at the beginning of the 1990s, the share of income concentrated in the largest CDs increased steadily from 1995 onward. Furthermore, rural CDs, particularly rural northern and rural non-metro-adjacent CDs, have a declining share of national aggregate income, meaning that they are becoming relatively smaller in aggregate terms.
- A preliminary assessment of persistence of conditions suggests a relative stability of conditions. Nonetheless, it is possible to identify clusters of CDs with persistently lower incomes in marginal and remote areas whose relative economic position is further deteriorating. In contrast, there are clusters of rich CDs in core regions whose relative economic position is further improving compared to the national average.

These findings suggest the following implications for policy and rural analysis:

- **Space matters in addressing income disparities, and it does so in an evolving manner**. Hence, the results indicate that territorial and regional policy could play a relevant role in addressing disparities. But spatial disparity appears to be shifting. Despite the fact the macro-regional disparities remain important, a focus on provincial indicators could overlook the emerging disparities caused by spatial differentiation *within* each province. If this trend is confirmed over the longer run, analytical and policy tools should adapt to reflect the emerging geography of income disparity.
- **Spatial economic concentration appears to be a steady process.** The income trends used in this study confirm the long-term trend toward concentration of economic activities observed in other studies. The results suggest that the growth of the "new economy" has been largely an urban or peri-urban phenomenon. These results point to the key role of urban core areas for regional and rural development.
- **The results suggest considering forms of territorial targeting based on small administrative units to address the increasing disparity in specific disadvantaged areas**. This study indicates the existence of persistent regions of lower average income, particularly in peripheral regions, which during the 1990s have further fallen behind. Some of these regions cut across provincial borders. An effort to reduce income disparity across Canada could increasingly focus on this specific type of disadvantaged regions.

Table of contents

1. Introduction **1**

2. A review of concepts **2**

3. A review of indices and measurements **6**

4. Application to Canada **9**

4.1 The data and background information 10

4.2 Average income trends: convergence and distribution shape 13

4.3 Aggregate income trends: concentration 19

4.4 Persistence of conditions: mixing and regional clusters 24

5. Conclusions and implications for policy **27**

References **29**

Appendix A: Summary table of measures and statistics **32**

Appendix B: Definition of total income **34**

Appendix C: Mathematical specification of the indices **35**

List of tables

Table		Page
1.	Summary table of dimensions and measures of territorial income disparity	9
2.	Summary statistics for the territorial units used in the analysis, 1996	11
3.	Income growth rates and correlation with CD population size	16
4.	Percent of CDs by range of average income	19
5.	Matrix of transition probabilities between income deciles	25

List of figures and map

Figure		Page
1.	Average total income of Canada	13
2.	Weighted indices of income dispersion	14
3.	Unweighted indices of income dispersion	15
4.	Decomposition of disparities by provinces and CD regional types	18
5.	Concentration: indices of dispersion of aggregate income	20
6.	Share of total income of the largest CDs	22
7.	Share of total income of the smallest CDs	23
8.	Evolution of aggregate income by regional type	24

Map		Page
1.	Median income level and trend by CD, 1992 – 1999	36

1. Introduction

The reduction of territorial disparities has become a policy priority for most OECD countries and, from a research perspective, one of the main objectives of territorial analysis is monitoring disparity trends across time. The recent literature on territorial disparities has been dominated by an econometric approach aimed at testing the convergence hypothesis (see, among many, Coulombe and Tremblay, 2000; Afxentiou and Serletis, 1998; Coulombe and Lee, 1998; Chatterji and Dewhurst, 1997; Hofer and Worgotter, 1997; Kangasharju, 1999; Petrakos and Saratsis, 2000; Barro and Sala-i-Martin, 1992). This approach is elegant and concise, but at the same time it provides a narrow understanding of territorial structures and processes of regional change (Quah, 1996b and 1993; Rey and Montouri, 1999; Lopez-Bazo *et al.*, 1999). The notion of territorial disparity has a complex connotation even when the attention is focussed on one indicator only, such as per capita income. It has been acknowledged that, in order to generate a better understanding of territorial trends, it is necessary to rely on a comprehensive set of measures that capture the multiplicity and complexity of the underling spatial processes (OECD, 2001).

This paper focuses specifically on income disparity. Some of the measures used in the territorial analysis of income distribution come from research on personal income inequality. Even though personal income inequality remains a major focus of interest for policy-making, the scope of territorial analysis is to highlight the relevance of space to income disparity. In this way, it reveals the potential role of territorial policies in addressing personal income inequality. Most of the convergence analysis has used average income indicators for the territorial unit of reference. However, changes of territorial average income are not the only relevant spatial process of change for territorial policies. The spatial structure of the aggregate regional income and the persistence of conditions for specific regions, regardless of the overall behavior of a cross-section of observations, are other dimensions of territorial disparity that have implications for public policy.

The paper has two main objectives. First, it reviews a broad set of concepts and related measures of territorial disparity that can inform the policy debate. Second, it applies these measures to the Canadian context, using data on income from income tax returns from 1992 to 1999, for about 280 Census Divisions covering the entire country. The opportunities to assess spatial disparity trends, in their various dimensions, have been limited by the availability of consistent and comparable data. Long and dense time series for small geographic units are difficult to obtain, and in many cases are simply not existent. This paper is based on a unique data set for Canada, which allows a more detailed geographic scale though at the expenses of a longer time series. According to these objectives, this paper is organized in five major sections. Section 2 reviews some conceptual definitions used in the analysis of territorial disparity. Section 3 presents a set of indices and measures that can be used to summarize the spatial processes. Section 4 presents an application of these indices to Canada. The conclusions, implications for policy and suggestions for further research are presented in Section 5.

2. A review of concepts

A variety of concepts have been used in the income disparity literature, such as inequality, polarization, concentration and convergence in its various forms. While these terms have been used in a misleading manner in some cases (Wolfson, 1989; Sala-i-Martin, 1996), each can be ascribed to a specific dimension of disparity, or a specific process of change in spatial income distribution. Although these dimensions are related, they remain to a large extent independent and should be assessed individually. The term *disparity* can be used in a broad sense to encompass these various dimensions, to describe the variations in wealth, socio-economic conditions and opportunities among units of observation or, more generally, to describe the variation of a socio-economic indicator to which is attached a normative connotation (i.e. high is desirable, low is not desirable, or vice versa).

In this paper, the focus is on three major dimensions of territorial disparity: (1) disparity in per capita income indicators, which relate in particular to the process of convergence; (2) disparity associated with aggregate income indicator trends, which relate in particular to the process of concentration; and (3) persistence of disparity conditions, which shifts the focus toward the performances of each individual territorial unit. These dimensions are used as a comprehensive framework that allows a broad assessment of territorial disparity and its trends. By looking at these three dimensions together it is possible to generate better insights into the nature of the spatial changes observed, and a more detailed picture that can contribute to the design or the evaluation of policies aimed at addressing spatial disparities. The reminder of this section discusses these three dimensions and the variety of concepts and spatial processes that can be associated with them.

The term *disparity* is used here in particular to describe the range of the cross-sectional variation among territorial units. The analysis of spatial disparity is concerned primarily with per capita indicators for each spatial unit, and when changes in disparity are assessed over time, the process of interest is typically *convergence* (or *divergence*). Hence, the essence of convergence analysis is to investigate whether the standard of living gap between regions falls over time. The term "convergence", however, has had different connotations in the recent literature. In particular, three definitions of convergence have been used in empirical analysis (Rey and Montouri, 1999; Sala-i-Martin, 1996).

The first type of convergence, which is that considered in this paper, refers to the cross-sectional dispersion of the indicator under study. This is generally referred to as σ-convergence (sigma-convergence). In this case, convergence occurs if the cross-sectional dispersion decreases over time. The second convergence concept implies that convergence occurs when the regions with lower income levels tend to record a greater rate of growth – in other words the relatively backward regions tend to catch up with the relatively advanced regions on the indicator of interest. This type of convergence is

referred to in the literature as β-convergence (beta-convergence).[2] There exists an extensive empirical literature on testing the β-convergence hypothesis but the empirical findings are somewhat inconsistent and controversial; furthermore, there seems to be an unsettled debate on the appropriateness of this approach in analyzing regional convergence.[3] Finally, a third form of convergence comes from time-series studies, and has been defined as stochastic convergence. This type of convergence implies that, in the long run, forecasts of income level differences between two economies goes to zero (see Rey and Montouri, 1999). While stochastic convergence has not received much attention in the literature, the previous two concepts of convergence have been widely applied and have been usually considered together in empirical studies. There exist in fact a relationship between σ-convergence and β-convergence, as β-convergence tends to result in σ-convergence. Nevertheless, the latter might be offset by new disturbances that increase dispersion even in the presence of β-convergence, and for this reason the two remain independent processes which cannot be properly captured by the same measure (see Barro and Sala-i-Martin, 1992; Sala-i-Martin, 1996).

It should be noted that convergence, in its various forms, does not imply that income becomes equal in all the regions. Hence, the convergence process is not supposed to proceed indefinitely. In theory, convergence is supposed to drive the system toward a *steady state* in which income disparity reaches an equilibrium condition that reflects a

---

[2] It should be noted that β-convergence has a twofold connotation, absolute and conditional convergence. The former implies that the process of convergence can be observed regardless of other socio-economic characteristics of the regions that are compared. In practical terms, this means that the coefficient of the "initial income" variable introduced in the regression model is significant and negative in a univariate regression. In contrast, if convergence is observed only when holding constant a number of other "conditioning" variables (which captures other socio-economic characteristics of the regions), then the observed process is defined as "conditional convergence". In practice, this implies using a multivariate regression model, where "initial income" is one of the explanatory variables but a number of other conditioning factors are introduced (for further details on this, see Sala-i-Martin, 1996).

[3] Although it is not in the scope of this paper to review the theoretical debate on the convergence hypothesis, it should be briefly mentioned that the controversy surrounding regional convergence arises from the debate of two opposing growth paradigms, the neoclassical growth theory and the endogenous growth theory. The two approaches have substantially different policy implications. In essence, according to the neoclassical perspective, convergence is due to the presence of diminishing returns to capital. Since the convergence process will operate to reduce initial income differentials, policy interventions to correct territorial disparity are viewed as unnecessary. In contrast, according to the endogenous growth theory the presence of increasing returns to scale leads to the possibility of persistent or even increasing levels of regional income disparities. The research focus on the convergence hypothesis, therefore, was seen as a means to test these two competing approaches towards economic growth. Yet, the empirical evidence and the theoretical and methodological foundations of this type of analysis have been at the center of an intense debate. Two articles in particular summarize the main points of the controversy. On the one hand, Quah (1996b) suggests that the concept of β-convergence is "misleading" in understanding convergence. His critique is both methodological - studying an average or representative economy gives little insight into the empirical behaviour of the entire cross-section - as well as technical - the "law of convergence" may be partially explained by a statistical artefact, the unit roots in the time series data. In contrast, Sala-i-Martin (1996) argues that β-convergence is, together with other convergence concepts, a relevant one; he also points out that although statistical problems are theoretically possible, they are unlikely to be the cause of the observed convergence.

different endowment of factors, productivity levels, and other structural characteristics of the regional economy.

The change in income dispersion, however, is not the only relevant process that describes the evolution of income distribution. A concept that has received particular attention in the analysis of personal income inequality is that of *polarization* of the income distribution. Polarization refers to the extent to which the observations tend to cluster into two distinct groups along a certain range of concern of the indicator (Wolfson, 1989; Wolfson and Murphy, 1998). The importance of the concept for the analysis of personal income inequality arises from the debate surrounding the hypothesis of a "disappearing middle class". There is, however, a corresponding concept that describes an analogous spatial process in regional science. This is put forward by Quah (1996b), among others, who suggests an interpretative model in which regional coalitions result in different convergence dynamics. These different dynamics imply that *convergence clubs* can be observed at various points of the income distribution. When two coalitions / convergence clubs are observed, the concept of *polarization* can be used to describe the outcome.[4] In this case, the income distribution moves from a unimodal shape to a bimodal one. Yet this is not the only possible outcome, as multiple modes in the cross-sectional income distribution could occur. In this case the term *stratification* would better describe the process of change in the cross-sectional distribution (Quah, 1996b). Finally, spatial clustering of territorial performance has also relevant implications for convergence analysis with econometric methods. This seems to be particularly true when small territorial units are used. Since the administrative boundaries do not necessarily overlap with the boundaries of the functional region that shares similar trends, spatial dependence is likely to be even more relevant at this geographic level of analysis (see Rey, 2001; Rey and Montouri, 1999).[5] These aspects are not discussed in depth in this paper because of the methods applied here. Nonetheless some of the results presented can be considered as a preliminary exploration in this direction.

A second major dimension of disparity used in this analysis concerns aggregate income indicators. When inter-temporal changes are considered this dimension refers in particular to the process of *concentration*. This concept implies a systematic tendency for economic activities and human settlement to locate in a restricted space. Although the opposite trend implies that economic activities become increasing diluted across space, an important distinction has been introduced in regional analysis between two different aspects of the de-concentration process. The distinction is between *decentralization* and *decongestion* (Coffey and Polèse, 1988). The former term is used to describe the process

---

[4] This is what Quah (1996) observes in his empirical analysis, with the rich regions getting richer and the poor getting poorer.

[5] The essence of this argument is that, in most of the econometric analysis of convergence (beta-convergence), each territorial unit has been implicitly viewed as an independent entity. Spatial spillover effects (and other forms of substantive spatial dependence), and spatial dependence due to the imposition of administrative boundaries that cut through functional regions (nuisance dependence), have been largely ignored (for a discussion of these problems see Rey and Montouri, 1997; for an application to European regions, see Lopez-Bazo *et al.*, 1999).

of dispersion of activities toward rural and peripheral areas, while decongestion is used to describe the process of extended sub-urbanization, or de-concentration within the urban field. Although these two processes are only preliminarily assessed in this paper, they are included in the conceptual toolbox for future reference and analysis.

A final dimension of disparity that is relevant for policy making and analysis is that of *persistence of disparity conditions* for a territorial unit. From a policy perspective, besides having indicators about the overall behavior of the entire cross-section of observations, it is also important to know how likely is *each* region to improve its conditions, how many did so, and what are their characteristics. In other words, whether or not the regions that were poor (rich) say twenty years ago are the same ones that are poor (rich) now has relevant policy implications. If the poor regions are persistently poor, one may want to consider (or reconsider) public programs aimed at enhancing the performances in these areas. On the other hand, if the income conditions are rotating over time, one could be less concerned about overall territorial income distribution. Intuitively, therefore, a focus on the persistence of conditions carries a more observation-specific type of information about changes in income disparity. While the previous dimensions place a greater emphasis on the behavior of the entire cross-section of observations (i.e. it is irrelevant whether a single territorial unit converges), here the attempt is to track in more detail the performance of each unit.

There are several aspects of persistence of conditions that could be singled out and conceptualized. Rey (2001) distinguishes in particular between the processes of *mobility* and *mixing*. The first refers to the movement of CDs across a cardinal scale of reference (such as fixed classes held constant over time). Mixing indicates changing position in the internal ranking of the unit of observation, hence this implies positional flows but not necessarily large income changes in absolute terms.

In sum, it should be stressed that these various dimensions of disparity, although interrelated, are to some degree independent from each other. For instance, from a theoretical standpoint, it can be shown that indicators of cross-sectional income dispersion do not provide adequate information on polarization. Overall, convergence and polarization cannot be summarized by a single measure because various combinations of the two processes are plausible (Wolfson, 1989). Similarly, overall convergence would provide limited insights into the persistence of low-income levels for some areas; while spatial economic concentration is compatible with both increasing and decreasing dispersion of income. The same holds true for mobility and mixing (Rey, 2001), and for σ-convergence and β-convergence, although the latter is not considered here (Sala-i-Martin, 1996).

Most importantly, each of these dimensions of disparity bears specific implications for territorial policies, and provides valuable information for policy design and analysis. While the analysis of average indicators is important from an equity perspective, assessing the changes in aggregate economic dimension of localities provides insights into potential development opportunities and options for each area. For instance, increasing disparity in aggregate territorial dimensions might restrict territorial

development options by reducing the regional size below the critical mass required to support local activities and basic services (health, education, transportation, and municipal services). This, in turn, could reduce the opportunities for average income growth. A comprehensive analysis of territorial disparity for policy purposes should take into account these various processes of spatial change. The following section provides a review of measures and indices that can be used for this purpose.

3. A review of indices and measurements

This section discusses a set of indices and statistics related to the concepts discussed above. These measures are also listed in Table 1. Many of them are well known and widely applied measures found in the literature on personal income inequality. For this reason, the following discussion focuses mainly on their relationship with the disparity dimensions. The reader interested in the formal derivation and properties of each statistic is referred to the original paper or specialized texts, while the mathematical specification of the indices used in the analysis is reported in the appendix.

The assessment of convergence / divergence trends (sigma-convergence) typically involves the use of one or more indices that measure the dispersion or degree of inequality of the variable being considered. Since the seminal contribution of Williamson (1965), the coefficient of variation has become one of the major indices of dispersion used in regional analysis.[6] The variance of logarithms of income has also been widely used for this purpose, while the Gini coefficient (see Gastwirth, 1972) and Theil's index (Theil, 1967) are a further two standard inequality measures used primarily in personal income analysis, but also widely applied to assess the degree of disparity in a regional context.

In the present study, all the measures mentioned above are employed. Each of these indices is more sensitive to changes in a different range of the income distribution, meaning that each can result in a slightly different trend, and each has specific properties (see also Kovacevic and Binder, 1997). Given a problem at hand, therefore, the choice of the most appropriate index could be driven by the range of the distribution in which the researcher is specifically interested. For instance, the coefficient of variation is more sensitive to high-income values. The Gini is sensitive to both high and low extremes of income distribution, and remains popular for its clarity and its ease of graphical representation. While the Gini offers a more easily interpretable picture of inequality, the Theil's index is considered a more mathematically elegant measure. Theil's index has all of the desirable properties of an inequality measure. It is symmetric (invariance under permutations of individuals), it is replication invariant (independent of population replications), it is mean independent (invariant under scalar multiplication of income), and it satisfies the Pigou-Dalton property (inequality increases as a result of a regressive transfer). It is also Lorenz-consistent, meaning that it agrees with the quasi-ordering that

---

[6] Another index used by Williamson (1965) and subsequently applied in several other studies is the mean absolute deviation (weighted and unweighted). Another index that is not used in this study but is found in some applications is the exponential measure (see Wolfson, 1986; Kovacevic and Binder, 1997).

can be derived from comparing Lorenz curves. Finally, the variance of logs is sensitive to low-incomes and its use is common but criticized by some (see Wolfson, 1989).

For all the above indices of dispersion, the computation generally involves weighting the income deviation from the national mean by the population share of the territorial unit. Implicitly, when the income deviation is weighted by the population share of the region, the resulting index captures the relevance of geography to personal income distribution. This means that an increase in the weighted dispersion indices would imply that space is becoming more relevant in capturing personal income inequality, and vice versa.[7] In other words, this approach maintains a people-focused analysis in a regional study context. Alternatively, it is possible to compute unweighted indices of dispersion, in which each territorial unit is given the same weight regardless of the fact that some may represent several thousands of people while others may represent only a few hundred. This procedure allows evaluation of the overall dispersion of territorial average incomes without the compounding effect of the population weights. In addition, the change in the index is not affected by changes in the relative population size of each area, but only by changes in the territorial dispersion of income. Therefore, this approach generates a more territorial-unit-focused understanding of change, which should not be overlooked when assessing territorial disparity.

Besides providing information on the overall income dispersion, some of the indices discussed above present an appealing property, which is referred to as decomposability (Theil, 1967). This means that if the observations are grouped into mutually exclusive and completely exhaustive groups, the total inequality (I_{tot}) measured by the index can be decomposed into a between-group component ($I_{between}$) and a within-group component (I_{within}). Thus, total inequality can be written as: $I_{tot} = I_{between} + I_{within}$. Theil's index is decomposable, due to the additive property of logarithms. This property will be used in the empirical part of this work to examine the relevance of some of the major spatial aggregates (such as provinces and CD regional types) to overall territorial disparities.[8]

Other statistics that are commonly used to measure income dispersion and its trends are quintiles or percentiles, and percentile ratios. These are not used here, in part to avoid duplication. Yet, these statistics, as with the other indices discussed above, are only concerned with spread-dispersion of average income across territorial units. An assessment of the changes in the shape characteristics of the distribution requires the use of other statistics. In this regard, some authors have used simple statistics such as skewness and kurtosis (see for instance Rey, 2001). In other cases, density plots and kernel density estimates are used to explore the evolution in income distribution across space and to generate a graphic representation of convergence, or other changes in the

---

[7] This would not necessarily imply, however, that personal income inequality had decreased or increased. This is because the computation is based on territorial *average* incomes, which do not provide any information on the personal income distribution (i.e. inequality) within each territorial unit.

[8] Theil's index is not the only decomposable index, the variance of logarithms and squared coefficient of variation also have this property. However Theil's index is the most commonly used because of its specific properties (see Theil, 1967).

shape characteristics of the territorial income distribution (see for instance, Rey, 2001; Johnston 2000; Lopez-Bazo *et al.*, 1999). Finally, Rey and Montouri (1999) employ a set of indicators based on the Moran's I statistic to explore the spatial patterns of autocorrelation in regional income changes. Rather than a specific process of change in the distributional shape, however, these measures capture the spatial dependence among units of observation. These measures are not applied in the empirical part of this study, and are simply listed for reference and future research.

Instead, following Wolfson (1989) and Wolfson and Murphy (1998), this study applies a straightforward measure of polarization, given by the proportion of observations in various income ranges around the national mean. For instance, the analysis considers the proportion of CDs with average income between 80 and 95 percent of the national average income, and its evolution over time. More rigorous and analytic polarization indices have been proposed in the literature (see Foster and Wolfson, 1992; Esteban and Ray, 1994; Kovacevic and Binder, 1997; Wolfson and Murphy, 1998). These are mentioned here for completeness, but they are not used in the empirical analysis presented in this paper.

The dispersion indices discussed above can also be applied to aggregate income indicators (instead of per capita indicators) to investigate whether or not the distribution of national aggregate income is becoming more concentrated in certain territorial units. An increasing cross-sectional dispersion of the aggregate territorial incomes implies that some territorial units had larger aggregate growth rates than others and some, in fact, might experience a decline of their aggregate size. The unweighted Theil's index can be used for this purpose. In its weighted formulation, the index sets a relationship between the share of aggregate income of a territorial unit and the population share of the same unit. Intuitively, if the share of income is equivalent to the share of population for all the regions, there would be perfect equality between territorial units. When income shares are not weighted by population shares, and each unit is treated as an observation with the same weight, the index captures the degree of disparity of aggregate income. As some units increase relative to others, that is income becomes more spatially concentrated, the disparity also increases, and vice versa. Finally, the concentration process can also be measured by the evolution of the national income share of different groupings of the largest and the smallest CDs[9].

Recently, some authors have developed alternative methods to the standard convergence analysis. These are based on a Markov chain approach, and in particular on empirical transition probability matrices. Examples of this approach are the studies by Quah (1993 and 1996a), Lopez-Bazo *et al.* (1999), and Rey (2001). These methods provide a set of measures and indicators that can describe the persistence or change in disparity conditions. A transition probability matrix is an analytical tool in a matrix format; each cell of the matrix shows the probability of a region making the transition from income

[9] As applied to CDs, small and large refers to national aggregate income and not to population size or geographical dimension.

category *i* to income category *j* over a certain period of time. When the income class boundaries that define the matrix are kept fixed, the analysis also provides insights into the evolution of the distribution of territorial units across income class boundaries over time. Territorial income convergence would be reflected by the distribution concentrating in the middle income classes, while the opposite would indicate territorial divergence. Furthermore, a number of indices that summarize the mobility in the distribution can be calculated from the transition matrix. Mobility indices, and extensions of these that include measures of mixing as defined in the previous section, are presented by Rey (2001). Also, Lopez-Bazo *et al.* (1999) present a measure of ranking changes. These indices are referred to here for completeness of the review. Their application is not fully developed in the empirical part of the analysis, and further consideration should be given to these measures in future research.

Table 1. Summary table of dimensions and measures of territorial income disparity

Dimensions of territorial income disparity	Measure
Per capita income disparity	
Relevance of space to personal income inequality	Weighted indices of dispersion: coefficient of variation, variance of the logarithms of income, Theil's index, Gini coefficient
Relevance of alternative spatial aggregations	Theil's index decomposition analysis (between/within groups inequality)
Territorial inequality	Un-weighted indices of dispersion: Coefficient of variation, variance of the logarithms of income Analysis of quintiles or percentiles and percentile ratios
Shape characteristics of territorial income distribution	Population shares in various ranges for the indicators of concern Polarization index Skewness, kernel density estimates
Aggregate income disparity	
Concentration (decongestion and decentralization)	Indices of dispersion applied to aggregate income, Aggregate income shares of grouping of territorial units
Persistence of disparity conditions	
Mobility and mixing	Transition probability matrix and associated mixing and mobility indices

4. Application to Canada

This section presents an application to Canada of some of the concepts and the associated measures of disparity reviewed above. There exists an abundant literature on regional disparity in Canada. However, the large majority of empirical work concerned with regional disparities in Canada has used provincial level data (see Coulombe, 1999 and references therein; Afxentiou and Serletis, 1998; Moazzami, 1997; Lefebvre, 1994; Maxwell, 1994). A limited number of studies have used small geographic area data such as Census Division data, mainly from the Census of Population (Shearmur and Polèse,

2001; Keddie and Joseph, 1991; Joseph and Keddie, 1988). To the author's knowledge, no research has assessed territorial income disparity trends in Canada using annual time series data for small geographic units and with a national coverage.

The findings of the research conducted to date show that, at the provincial level, the dispersion indices of various income and output measures record a substantial convergence among provinces from the 1950s to the mid-1980s (Coulombe, 1999). Since the mid-1980s, the catch-up convergence process appears to have come to an end. The dispersion indices converge slowly suggesting that the system is approaching a steady state. According to Coulombe (1999) the level of regional (i.e. provincial) disparities in Canada are close to a condition of disparity equilibrium, which reflects the industrial structure, and the institutional and political context.[10] On the other hand, Shearmur and Polèse (2001) observe a steady process of concentration of the economic activities between 1971 and 1996. While Keddie and Joseph (1991), Joseph and Keddie (1988) and Coffey and Polèse (1988), after assessing population and employment trends, suggest that most of the alleged process of decentralization supposed to have occurred over the 1970s and the 1980s is in fact decongestion, due to urban spillovers into adjacent rural areas.

Part of the contrasting results that are often encountered in comparing empirical studies, however, can be explained by the variety of research methods, technical definitions and caveats applied by different studies. In particular, three questions should be kept in mind when comparing research results. First, disparity of what? This implies a clear definition of the income concept used. Second, disparity among whom? This refers in particular to the level of geographic aggregation. Third, disparity over what time horizon? The time frame may considerably alter the outcomes of the assessment. Before presenting the results of the analysis, therefore, the following section outlines some answers to these questions.

4.1. The data and background information

All the data used in this analysis are from the Neighborhood Income and Demographics database of the *Small Area and Administrative Data Division* (SAAD), Statistics Canada. This data set contains income and basic demographic variables for all persons reporting income by small geographic units. The data is derived from income tax returns and is updated annually. Details on data quality, coverage, confidentiality and rounding procedures are provided in Statistics Canada (2001). It should be noted, however, that in 1999 about 71.4 percent of Canadians of all ages filed tax returns, and the coverage of income was over 90 percent.

The geographic level of the analysis is the Census Division (CD), which is the smallest standard geographic unit for which the data are readily available. This corresponds to

---

[10] Testing of the convergence hypothesis (beta-convergence) has produced somewhat more controversial findings. Coulombe and Lee (1993) find that convergence has occurred for a variety of income and output measures, and Coulombe and Tremblay (2001) obtain similar results for human capital indicators. Analogous results are obtained in other studies. On the other hand, Afxentiou and Apostolos (1998) show that evidence of beta-convergence among provinces disappears when more statistically rigorous tests are used.

territorial level 3 of the OECD classification. Geographic consistency across time remains one of the major challenges when working with small territorial units in the Canadian context. Changes in the CD boundaries limited the time span used for this paper, and required dropping some observations from the analysis.[11] Of the 288 CDs available in the original dataset for the years 1992 to 1999, a total of 278 were used in the present analysis. The territorial units dropped included the CDs in the northern territories plus four CDs in British Columbia (see the CDs labelled "no data" in Map 1).

Table 2 presents a set of summary statistics about the 278 CDs included in this study. These figures can be of particular use when comparing this study with analogous research conducted in other national contexts. However, they also point to the fact that the size and the distribution of the territorial units are not homogeneous across the country. For instance, the administrative geography of Quebec implies that over a third of the observations are located in that province. Most of the analysis is not affected by the provincial location of a CD. Nevertheless, for the computation of some indices, such as the unweighted dispersion indices, the observed distribution implies that the results are more sensitive to changes that occur in regions with a fragmented administrative geography.

Table 2. Summary statistics for the territorial units used in the analysis, 1996

Province	Number of CDs	Area ('000 Km^2)			Population ('000)		
		Total	CD average	Std. dev.	Total	CD average	Std. dev.
Newfoundland	10	372	37.1	80.3	547	54.7	68.8
P.E.I.	3	6	1.9	0.2	133	44.3	25.0
Nova Scotia	18	53	2.9	1.0	900	50.0	76.8
N.B.	15	72	4.8	3.0	730	48.6	30.9
Quebec	99	1,358	13.7	75.5	7,045	71.1	184.3
Ontario	49	917	18.7	61.1	10,643	217.2	364.9
Manitoba	23	548	23.8	51.1	1,100	47.8	123.9
Saskatchewan	18	570	31.7	55.3	977	54.2	63.3
Alberta	19	638	33.6	42.0	2,669	140.5	263.5
B.C.	24	570	23.8	24.9	3,408	142.0	361.6
Total CDs included	278	5,103	18.3	59.3	28,151	101.3	237.2

Note: Yukon and Northwest Territories are not included in the analysis.
Source: Area and population figures are computed using Census of Population 1996 data.

The main income concept used in this study is total income per person reporting any income (i.e. total income divided by total persons reporting any income), which for sake

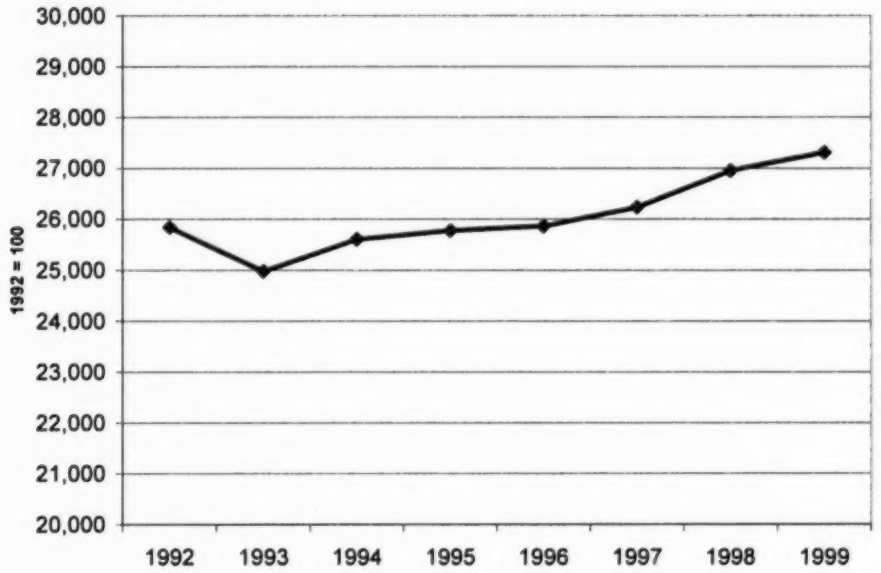
[11] Data for the period 1986-1991 have been also made available and will be included in a geographically consistent database for further analysis.

of brevity is hereafter referred as average income.[12] Hence, this definition includes what in broad terms are identified as market income and government transfers, and it is before taxes. The detailed definition used by the SAAD was revised over the years, and minor items such as allowances, benefits, and pension plans were introduced into the total income computation at different points in time (Statistics Canada, 2001). Appendix 2 provides further documentation about these changes, which inevitably introduced some noise in the analysis. Finally, monetary values provided by the SAAD were in current terms, since they are updated on an annual basis. All the income values used in the study were converted to 1995 dollars, using the Consumer Price Index (CPI) deflator at the provincial level (Statistics Canada, Table 326-0001). Hence, the results take into account the different inflation rates among the provinces.

A final piece of background information that should be kept in mind when reading the results section is the overall economic context for the period covered by the study. Figure 1 displays the national average total income (also in this case, per person reporting any income) between 1992 and 1999 in constant 1995 dollars. Over the last twenty years, the Canadian economy experienced two recessions, one in the early 1980s and the other in the early 1990s. The latter, which is relevant to this study, hit primarily Eastern Canada and in particular the urban region surrounding Toronto. As shown by the figure, since 1994, Canada has experienced sustained growth of average total income, despite the shocks of the late 1990s.

[12] Note that in the context of this study the term *total* income is used to indicate employment income (wages and salaries plus net self-employment income) plus investment, government transfers, and pension and other income for individuals, while *aggregate* income refers to the sum of total incomes for a given geographic area.

Figure 1. Average total income of Canada, 1992-1999

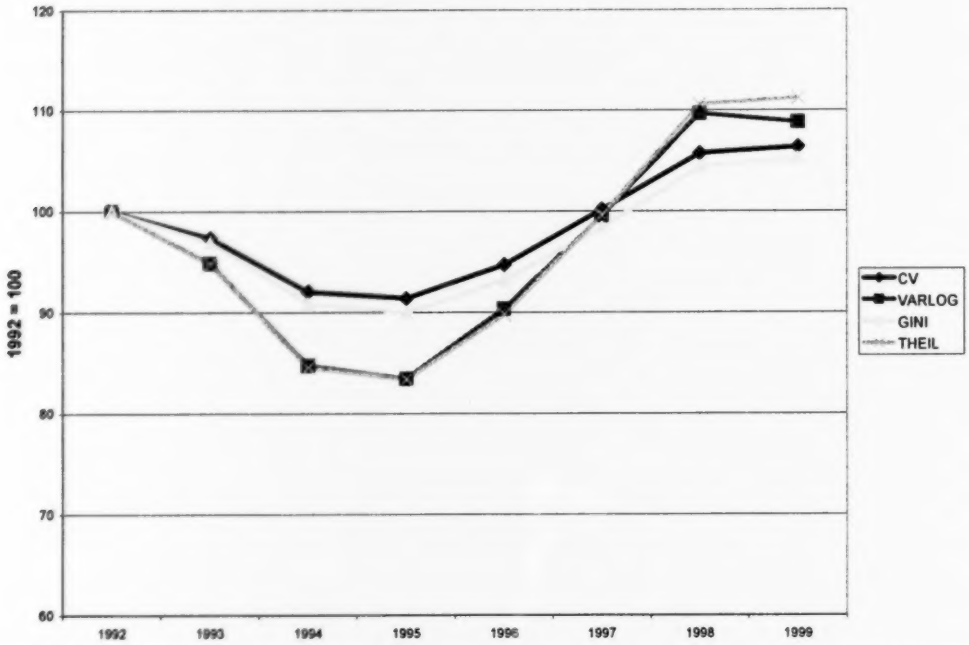


Note: Average is computed for persons reporting any income. Income is before tax.
Source: Calculations based on Small Area and Administrative Data, Statistics Canada.

4.2. Average income trends: disparity, convergence, and distribution shape

The first dimension of territorial disparity presented here relates to the widely debated issue of regional convergence (sigma-convergence). Figure 2 displays the trend of the weighted indices of dispersion of average total income from 1992 to 1999. The indices are the coefficient of variation (CV), variance of the logarithms of income (VARLOG), and the Theil's and Gini coefficients. For ease of comparability, each series is normalized so that the 1992 value equals 100. The actual values of the indices are reported in Appendix A. The indices of income dispersion show overall territorial divergence over the period considered. However, the convergence / divergence path tends to resemble the business cycle of the national economy. During the sharp recession of the early 1990s, the dispersion indices present a converging trend. This trend is reversed during the phase of economic expansion, in particular after 1995, and by 1999 the indices of dispersion are higher than in 1992.

Figure 2. Weighted indices of income dispersion, 1992–1999



Note: 1992 values equal 100. Original values are in the appendix. The figure is scaled to highlight relative changes.
Source: Calculations based on Small Area and Administrative Data, Statistics Canada.

Figure 3. Unweighted indices of income dispersion, 1992 - 1999

Note: 1992 values equal 100. Original values are in the appendix. The figure is scaled to highlight relative changes.
Source: Calculations based on Small Area and Administrative Data, Statistics Canada.

Figure 3 presents the trend of unweighted indices of dispersion. In this case, only the coefficient of variation (CV) and the variance of logarithms (VARLOG) are used. The trends are to some extent similar to those of the weighted measures – the overall disparity is higher in 1999 than in 1992 and the path tends to track the national business cycle. Furthermore, the end of the phase of economic expansion / divergence initiated in 1994 appears more evident in this graph. Between 1998 and 1999, both indices record a turn around of the diverging trend started in the mid-1990s. What happened between these years is that the more populous CDs grew more slowly than the less populous one. Thus, dispersion indices that are not weighted for the population share clearly display this catch-up of the units with small population.

Table 3 helps in understanding the growth dynamics that resulted in the observed trends in dispersion indices. The upper part of the table indicates the annual growth rates of average CD income by OECD regional types (predominantly rural, intermediate, and predominantly urban). The pattern appears clear – during economic recession rural CDs do not lose as much as intermediate and urban CDs. Then, during the first year of recovery, rural gains more than urban but less than intermediate regions. For almost all the years after this, rural income growth rates are lower than intermediate and urban rates. Moreover, it appears that before the mid-1990s, intermediate regions are leading, but after the mid-1990s urban increases rapidly. Finally, the last two years (1998-99) indicate again that the growth rate gap is closing between the three groups. Rural and urban are

very close, but intermediate regions have slightly higher growth. This probably accounts for the turn around of the unweighted indices of dispersion.

The last row of the table indicates the simple correlation coefficient between the annual income growth rate (between year t and t_{-1}) and population size (at time t). Despite the fact that the correlation is generally small, the signs of the relationship are quite informative and further explain the territorial trends captured by weighted and unweighted indices. During recession, the correlation between growth and size is negative (small CDs have relatively higher growth rates). In contrast, over the phase of economic expansion (in 1994-1998) the correlation is larger and positive, meaning that the CDs with largest population, presumably urban and peri-urban, experience an economic take off with a growth rate larger than the smaller CDs. Over the last two years (1998-99) there is again a small turnaround. The sign of the correlation turns back to negative, even if the value is very small.

Table 3. Income growth rates (percent) and correlation with CD population size

OECD regional type	1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99
Predominantly rural	-2.76	2.86	0.62	-0.14	0.79	1.65	1.19
Intermediate	-3.52	3.23	0.99	0.07	1.26	2.57	1.63
Predominantly urban	-3.61	2.07	0.55	0.67	1.76	3.25	1.23
Growth rate and population size correlation	-0.117	-0.136	-0.043	0.152	0.145	0.185	-0.045

Source: Calculations based on Small Area and Administrative Data, Statistics Canada.

As discussed in Section 3, one of the properties of Theil's index is decomposability, meaning that once the CDs are grouped into exhaustive and mutually exclusive sets, the total disparity can be expressed as the sum of the between-group disparity and the within-group disparity. This allows an evaluation of the evolution of average income disparity *between* groups and income disparity among CDs *within* each group. The present analysis decomposes the total territorial disparity by grouping CDs into provinces, OECD regional types and Statistics Canada regional types. The latter classification is based on the OECD categorization but it further disaggregates the rural type into rural metro-adjacent, rural non-metro-adjacent and rural northern regions.[13]

The complete set of figures resulting from the decomposition analysis is reported in Appendix Table A.1. In all cases, the within group disparity accounts for the largest part of total income disparity (between about 50 to 60 percent). Moreover, the within-group disparity is generally higher for regional type classifications than for provinces. Not

[13] For the analysis of Statistics Canada regional types, four groupings are used where there is one urban group consisting of predominantly urban and intermediate census divisions and predominantly rural census divisions are grouped as rural metro-adjacent, rural non-metro-adjacent, and rural northern census divisions.

surprisingly, given the size and diversity of the country, the disparithy between ten provinces account for more of the total disparity than only three or four groups.

Nevertheless, the trends of relative disparity explained by between and within groupings appear particularly interesting. These trends are presented in Figure 4, which shows the ratio of within-group disparity to total disparity for the three classifications considered (provinces, OECD, and Statistics Canada regional types). For the provinces, the share of within-group disparity increases between 1992 and 1999, meaning that spatial disparity *within* the provinces increased more than total disparity. This also means that the share of between-province disparity decreased.[14] This implies that CDs within each province have become more heterogeneous over the period considered, and provincial aggregates capture a decreasing share of the total, and increasing, territorial disparity. In contrast, the regional types capture a slightly increasing share of total income disparity. In sum, over the 1990s, the spatial income divides appear to have shifted, not dramatically but rather steadily, from a provincial to a rural / urban divide.

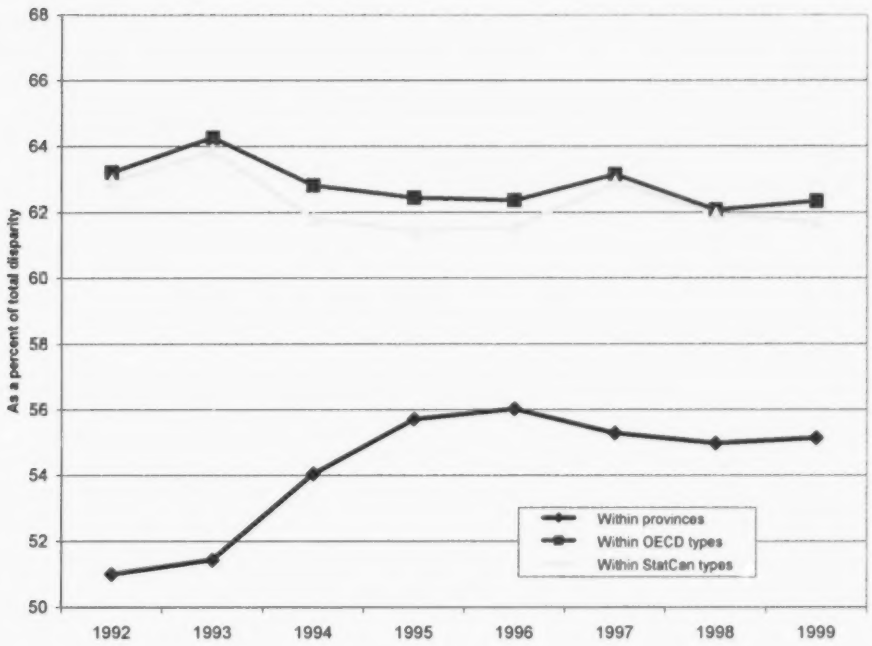
These results seem consistent with findings of other research that record increasing income disparity within each province of Canada from 1980 to 1998 and in particular through the 1990s (Sanga, 2000). The prevailing view on provincial disparities is that they have reached a steady state since the mid-1980s (Coulombe, 1999). But this view seems to miss part of the story on the emerging patterns of territorial disparity across Canada. The results presented here and the findings of other research would support the hypothesis that the macro-convergence among provinces, or essentially a steady state at this level, was combined, at least during the 1990s, with a process of micro-divergence among sub-provincial territorial units.[15] If further confirmed, these results would have some noteworthy implications for regional analysis. Specifically, they suggest that regional studies would increasingly require a renewed spatial perspective, which places a greater attention on the dynamics of small geographic units, rather than on provincial aggregate trends.

---

[14] The value of the disparity indices between provinces decreased from 1992 to 1997, and then increased back to essentially the same level of 1992. The coefficient of variation and variance of logarithms computed on provincial average income data are reported in Appendix Table A.1. All the indices show essentially the same trend, with the 1999 level only marginally higher than the level in 1992, indicating that provincial comparisons would not capture most of the existing territorial disparities.

[15] It should be noted that this hypothesis would also be consistent with the recent finding by Coulombe (2000), which indicates that provincial convergence (beta-convergence) is significantly and positively affected by the level of urbanization of the province. This would suggest that convergence is due to the relative increase in the urban population. The more the province is urbanizing, the more its provincial average income converges to the national average, while at the same time the spatial disparity *within* each province could increase, as the present analysis suggests.

Figure 4. Decomposition of total disparity by provinces and CD regional types, 1992-1999



Note: The original values are reported in the appendix (Table A3). The figure is scaled to highlight changes.
The "OECD regional types" refer to three groups of census divisions: predominantly urban; intermediate; and predominantly rural.
The "Statistics Canada regional types" refer to four groups of census divisions: an urban group comprised of predominantly urban and intermediate census divisions plus three predominantly rural groups (rural metro-adjacent, rural non-metro-adjacent and rural northern census divisions).
Source: Calculations based on Small Area and Administrative Data, Statistics Canada.

Finally, Table 4 provides some preliminary insights on the polarization question. The table shows the percentage of CDs that fall into given ranges about the national average income. The changes are not dramatic, but they show a slightly increasing number of units in the top category, and a larger shift toward the two bottom categories. Even though a more accurate assessment of polarization should be carried out with a sharper analytical approach (such as polarization indices), this preliminary analysis would suggest a movement of CDs away from the central ranges toward the opposite ends of the distribution. Furthermore, the skewness of the distribution, another simple cross-sectional statistic, suggests that the positive tail of the distribution moved away from the national average. The skewness is positive for all the years considered, but after a slight decline between 1992 and 1994, it increases steadily from 0.23 in 1995 to 0.71 in 1999. These results remain preliminary and further analysis should be conducted in this direction.

Table 4. Percent of CDs by range of average income, 1992-1999

CD average income as percent of national average income	1992	1993	1994	1995	1996	1997	1998	1999
120 percent and over	1.4	1.4	1.4	1.4	1.4	1.8	1.8	1.8
105 to 120 percent	8.6	8.3	8.3	7.9	7.9	7.9	7.2	6.1
95 to 105 percent	19.4	20.9	22.3	22.3	21.2	19.1	16.9	17.6
80 to 95 percent	31.3	31.3	33.1	34.2	32.7	30.9	33.1	33.5
Below 80 percent	39.2	38.1	34.9	34.2	36.7	40.3	41.0	41.0

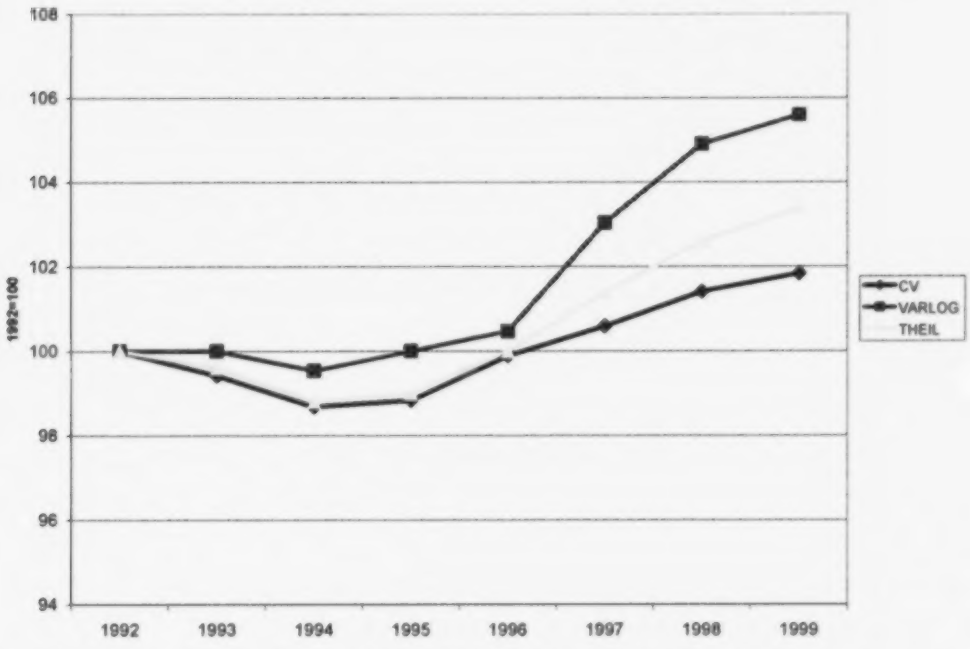
Source: Calculations based on Small Area and Administrative Data, Statistics Canada.

4.3. Aggregate income trends: concentration

A second major dimension of territorial imbalance is represented by different rates of aggregate growth between regions. This may be due to a concentration of economic activities in a few core areas and the marginalization of other areas. Average income trends do not provide any information in this regard. To evaluate aggregate changes, the dispersion indices are applied to the CD's aggregate income figures, then the trends of aggregate income share of alternative grouping of CDs are examined. The results indicate an increasing spatial concentration of income between 1992 and 1999. Again in this case, the trends tend to follow the path of the business cycle.

Figure 5 displays the dispersion indices applied to the cross-section of CD aggregate incomes (in this case the indices used are the coefficient of variation, the variance of logarithms and Theil's index). Similar to average income indices, growing trends of these indicators would imply that the cross-sectional spread has widened over time, and vice versa. The path followed by the indices is not different from those recorded in the case of average income. After a slight phase of convergence (meaning de-concentration of income) from 1992 to 1994, the aggregate income indices show steady divergence between 1994 and 1999.

Figure 5. Concentration: indices of disparity of aggregate income, 1992-1999



Note: 1992 values equal 100. The figure is scaled to highlight relative changes. Original values are in the Appendix.
Source: Calculations based on Small Area and Administrative Data, Statistics Canada.

Further information about the nature of spatial economic concentration is provided by Figure 6. This figure displays the share of national aggregate income captured by the largest 5, 10, 20, 30, 50 and 100 CDs across Canada (data is also reported in Appendix A). During the first half of the 1990s, each group of larger CDs show a slight decrease of their relative share of national aggregate income. This trend is reversed during the second half of the decade. By 1999, income was more concentrated in a restricted number of CDs. The share of aggregate income in each group grew each year from the mid-1990s to the end of that decade, except for the grouping of the largest 5 CDs, which was essentially flat between 1998 and 1999. However, these 5 CDs increased their aggregate income share by 2.8 percent over the eight years considered. The top 10 CDs gained 3 percent, and the top 50 CDs 1.3 percent.

In contrast, Figure 7 illustrates the evolution of the aggregate income shares of the smallest CDs. Similar to the largest CDs, six groupings are considered which range from the 5 smallest CDs in the aggregate income ranking to the 100 smallest CDs. The trends are the opposite of those observed for the largest CDs. Furthermore, except for those groups encompassing the smallest 20 CDs, which show a more irregular trend, the decline is almost continuous over the period considered. It should be also noted that for a sizable share of these CDs the aggregate economic decline is not only in relative terms, but also in absolute terms. In any given year, approximately 15 percent of all CDs

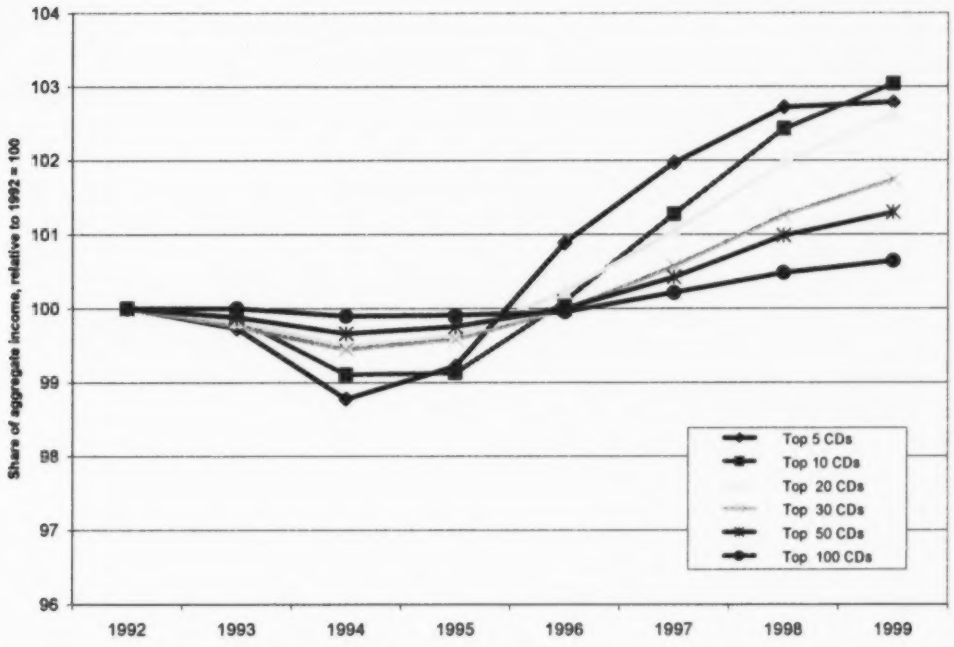
experienced an absolute decline in aggregate income size. It should be noted that these were not always the same CDs.

Is this process associated in some way with the CDs regional type? As can be expected by looking at the results presented so far, it appears to be so. Figure 8 shows the evolution of the national aggregate income shares by Statistics Canada regional types. For ease of comparison, the 1992 values are set to 100. The changes are not large in absolute terms, and the figures are reported in Appendix Table A.1, but the trends are quite clear. Rural northern regions and rural non-metro-adjacent regions have shrunk in relative terms over the entire period considered, losing 5 to 10 percent of their initial aggregate income share. Rural metro-adjacent CDs have remained essentially stable, fluctuating around their original share. CDs in urban and intermediate regions have gained slightly, in particular in the second half of the decade.

The debate on the concentration of economic activities, and the increasing agglomeration of population, presents somewhat contrasting views. The empirical evidence points to a series of reversals through time. Thus, extrapolation of short-term results over a longer period should be done with caution. However, both on theoretical and empirical grounds, there is evidence that concentration is one of the most pervasive characteristics of recent economic growth. In a recent study, Shearmur and Polèse (2001) noted a long-term trend towards the concentration of economic activities in metropolitan areas, as measured by employment trends.[16] The results of this study, therefore, would confirm the tendency toward economic concentration for the 1990s, and would also support the view that de-congestion has been the prevailing process when growth was not concentrated in the urban core. Moreover, these results appear interesting for what they tell about the nature of economic growth over the 1990s. Even in a decade marked by the rise of the "new economy", which according to some is less dependent on location, the centripetal forces leading to economic concentration seems to have prevailed over the centrifugal forces that should have led to de-concentration (see also Quah, 1996a).

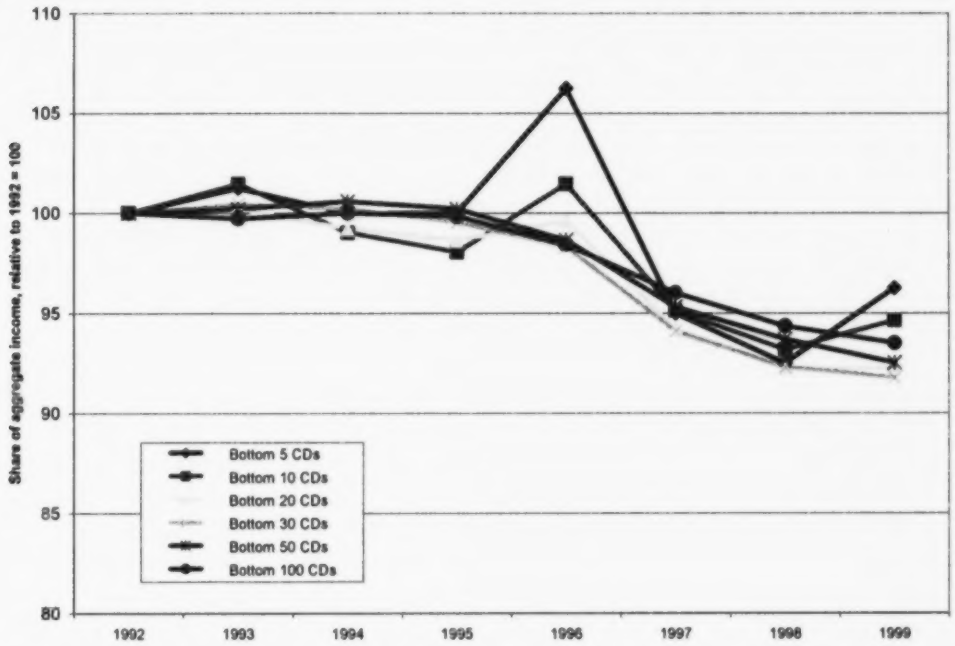
[16] A theoretical analysis of the forces that lead to increasing spatial concentration of economic activities (such as increasing returns to scale, and labour market pooling) is presented among others by Krugman (1991) and Thisse (1993).

Figure 6. Share of aggregate income of the largest CDs*, 1992-1999



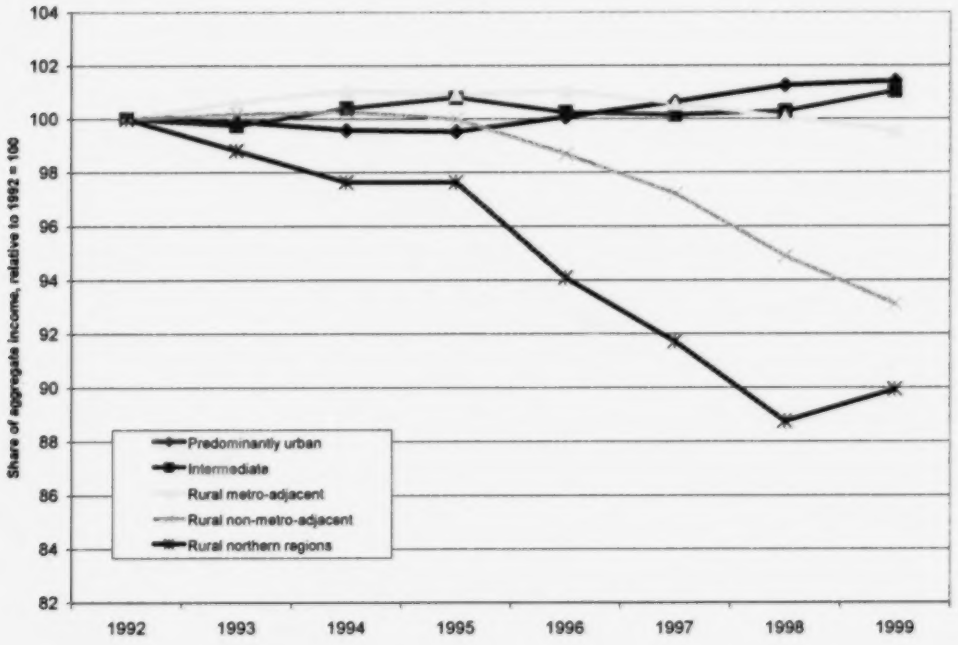
Note: 1992 values equal 100. Original values are in the appendix. The figure is scaled to highlight relative changes. The figures in brackets in the legend indicate the percentage of the total CDs represented by each grouping.
* As applied to CDs, small and large refers to national aggregate income and not to population size or geographical dimension.
Source: Calculations based on Small Area and Administrative Data, Statistics Canada.

Figure 7. Share of aggregate income of the smallest CDs*, 1992-1999



Note: 1992 values equal 100. Original values are in the appendix. The figure is scaled to highlight relative changes. The figures in brackets in the legend indicate the percentage of the total CDs represented by each grouping.
* As applied to CDs, small and large refers to national aggregate income and not to population size or geographical dimension.
Source: Calculations based on Small Area and Administrative Data, Statistics Canada.

Figure 8. Evolution of aggregate income by regional types, 1992-1999



Note: 1992 values equal 100. Original values are in the appendix. The figure is scaled to highlight relative changes.
Source: Calculations based on Small Area and Administrative Data, Statistics Canada.

4.4. Persistence of disparity conditions: mixing and regional clusters

The final dimension of disparity considered shifts the focus onto the performance of the individual CDs rather than on the overall behavior of the system. The empirical analysis presented below represents only a first exploration in this direction, and does not pretend to cover all the aspects discussed in Sections 2 and 3. These preliminary insights are based on a transition probability matrix and a simple classification and mapping of the economic performance of CDs over the period of time considered.

Table 5 represents a transition probability matrix between average income deciles from 1992 to 1999 for the 278 CDs. The rows indicate the CD average income decile in 1992, the columns indicates the decile in 1999. The values in the matrix represent the probabilities of a CD making the transition from decile *i* to decile *j* over the period 1992-1999. Thus, the diagonal indicates the probability that a CD remains in the same decile. For instance, 54 percent of the CDs that in 1992 where in the second (lowest) decile are still in the same decile in 1999; 25 percent have moved to the higher decile, 4 percent have moved up into the fourth decile and about 18 percent have moved down to the bottom decile. Given the way the matrix is constructed (using deciles), the information

that it provides in this table relates more to the 'mixing' aspects (i.e. positional flows of the CDs), rather then to mobility in terms of absolute changes in average income.
Because of the short period of time considered, most of the CDs remain in the same decile between 1992 and 1999. Therefore, it is not surprising to observe a general persistence of status in terms of ranking. However, some CDs show a considerable mobility in the income ranking, and it appears that the flows are relatively higher for some grouping of deciles while they are more sporadic for others. In particular, while the probability of changes is relatively high among the four lowest deciles, the flows are smaller between these and higher deciles and a break seems to occur between the fourth and fifth decile. Similarly the mixing is higher between the top four deciles, but more limited between the central and top four deciles.

Table 5. Matrix of transition probabilities between income deciles, 1992 to 1999

Deciles	1st (lowest)	2nd	3rd	4th	5th	6th	7th	8th	9th	10th (highest)	
1st (lowest)	0.78	0.22	0	0	0	0	0	0	0	0	1.00
2nd	0.18	0.54	0.25	0.04	0	0	0	0	0	0	1.00
3rd	0.04	0.21	0.54	0.21	0	0	0	0	0	0	1.00
4th	0	0.04	0.21	0.57	0.14	0.04	0	0	0	0	1.00
5th	0	0	0	0.18	0.57	0.25	0	0	0	0	1.00
6th	0	0	0	0	0.29	0.43	0.29	0	0	0	1.00
7th	0	0	0	0	0	0.29	0.46	0.14	0.07	0.04	1.00
8th	0	0	0	0	0	0	0.18	0.50	0.25	0.07	1.00
9th	0	0	0	0	0	0	0.07	0.36	0.46	0.11	1.00
10th (highest)	0	0	0	0	0	0	0	0	0.22	0.78	1.00

Source: Calculations based on Small Area and Administrative Data, Statistics Canada.

Persistence of disparity conditions are further explored with a mapping exercise. Map 1 provides a straightforward representation of income levels and patterns of change between 1992 and 1999, based on a four-category classification. For this classification the median CD income was used instead of the average income. Two categories of income level were generated: the first include the CDs whose median income was above the national median income for 6 or more years out of the 8 years considered. The second includes the CDs that presented a median income below the national median for 6 or more years out of the 8 years. Similarly, two trend classes were defined by fitting a trend line to the CD's relative median income (relative to the national median). The slope coefficient of the time trend was used to classify the CDs into two groups. The group named "increasing" includes CDs with a trend slope that is positive and greater than 0.2. The group named "decreasing" encompasses the CDs with slope trend smaller than –0.2.

Combining these two level and two trend categories, a classification of four CD types is obtained. One group consists of CDs which are persistently below the national median income and whose relative income tends to decrease over time – in other words, these are the poorer CDs that are getting poorer (dark red). At the opposite end are the CDs that are

persistently above the median income whose median income is growing relative to the national level (dark green) – in other words these are richer CDs that are getting richer over time. The two intermediate classes (light red and light green) are those that that converge toward the national level. All the CDs that do not fall in one of these categories (that is, those reporting fluctuating trends) are collapsed into the "mixed" group.

While the approach is analytically simple, the map suggests some preliminarily conclusions about the persistence of disparity conditions. Firstly, there is some evidence of diverging trends between clusters of CDs. Not only do some areas record a median income that is persistently below the national level, but some of these regions also show a deterioration of their relative position. Hence, the map indicates the location, typically peripheral, of persistent pockets of poor CDs that are getting relatively poorer over time. These CD clusters are found in the Atlantic provinces, particularly in Newfoundland and the north part of New Brunswick, an area stretching north between Toronto, Ottawa and Sudbury, northern Manitoba and in southern B.C. In contrast, there are clusters of CDs that present the opposite characteristics; these have median income persistently above the national level and are moving further away form it. Thus, these are rich CDs that are getting richer over time. Their location is typically close to urban cores. However, it does not always include the urban core itself and often extends far beyond it. Clusters of these CDs are found around Montreal, in southwestern Ontario, around Winnipeg, and the Census Divisions of Regina and Calgary.

Finally, the patterns that emerge from the map suggest a considerable degree of spatial clustering of CDs with similar economic performances. As it as been observed in other empirical analysis (Rey and Montouri, 1999), income trends are spatially dependent, and this is particularly obvious when small geographic units are considered. Hence, each CD should not be viewed as an independent observation, and the potential for spatial interactions should not be ignored if econometric methods were to be applied to assess convergence in this context.

5. Conclusions and implications for policy and research

This paper presented a broad overview of concepts and associated measures of territorial income disparity, which showed that no single measure captures in an adequate manner the variety of spatial processes of change that are relevant for an understanding of territorial trends. These spatial processes are to some degree independent from each other. For this reason, an assessment of territorial disparities for policy purposes should rely on a broad set of measures, each providing information on a specific dimension of disparity and which in combination provide a comprehensive framework for policy analysis.

The empirical application to Canadian data for the period 1992-1999 demonstrates the relevance of each measure in the context of a small geographic area analysis. Most of the existing research on regional disparities in Canada has used provincial level data, and has focused on testing the so-called β-convergence. This approach has limited the understanding of the territorial structure of disparity and its evolution. The present work employed Census Division data, which provides a more detailed geographic scale, even though at the expense of a longer time series. The short period of time considered is problematical. In particular, it makes it difficult to discern whether the patterns reflect long-term trends or short-term cyclical fluctuations. Thus, the results should be interpreted carefully particularly when conjecturing about longer-term trends. Indeed, a major objective of future research would be to extend the time frame of the analysis. Despite the first-pass nature of this study, the analysis produced some noteworthy results that can be summarized as follows:

- Between 1992 and 1999, the territorial income disparity in Canada increased. The convergence / divergence path that was observed follows closely the national business cycle with divergence associated with the stage of economic expansion of the late 1990s. Far from implying any empirical regularity, these results point to the nature and characteristics of economic growth through the decade.
- Decomposition of the total disparity indicates that the relative importance of income disparity due to between-province disparity decreased over the 1990s, while within-province disparity increased substantially. In other words, the average provincial income is less relevant in explaining the increasing spatial disparity. In contrast, the disparities between CD regional types (rural and urban) became relatively more important. Although the changes are not dramatic, and despite the fact that provincial differences remain sizable, the geography of income disparities is shifting slowly but steadily from a provincial to a rural / urban divide.
- There is an increasing concentration of aggregate income in a small number of CDs. After a slight decrease at the beginning of the 1990s, the share of income concentrated in the largest CDs increased steadily from 1995 onward. Furthermore, the income share of the smallest CDs declined almost steadily from 1992 to 1999.
- A preliminary assessment of persistence of conditions suggests a relative stability of conditions, which is not surprising given the short period of time considered. However, it is possible to identify clusters of CDs with persistently lower incomes in

marginal and remote areas whose relative economic position tends to further deteriorate through time. In contrast, there are clusters of rich CDs in core regions whose relative economic position is further improving compared to the national average.

The following general conclusions and implications for policy and research can be drawn from these findings:

- **Space matters in addressing income disparities, and it does so in an evolving manner**. If a decline of territorial income disparities was recorded, one could conclude that space has become *less relevant* in addressing income inequality. But if space matters at *a certain level of geographical scale*, then territorial policy could be used to address income inequality. The findings suggest that space matters (i.e. territorial and regional policy could play a relevant role in addressing disparities) but it does so in an evolving manner. Despite the fact the macro-regional disparities remain important, a focus on provincial indicators could overlook the emerging disparities that appear to be increasingly determined by spatial differentiation *within* each province. If this trend is confirmed over the longer run, analytical and policy tools should adapt to reflect the emerging geography of income disparity.
- **Spatial economic concentration appears to be a steady process.** Even in a decade marked by the rising of the "new economy", the long-term trend toward concentration of economic activities observed in other studies is confirmed by the income indicators used in this study. The results suggest that the growth of the "new economy" has been largely an urban or peri-urban phenomenon, which has led to further spatial economic concentration. These results point to the key role of urban core areas for regional and rural development.
- **The results suggest that forms of territorial targeting based on small administrative units should be considered to address the increasing disparity in specific disadvantaged areas**. The maps indicate the existence of persistent regions of lower average income, which during the 1990s have further fallen behind in relative terms. These are typically peripheral areas and in some cases cut across provincial borders. An effort to reduce territorial income disparity across Canada could increasingly focus on this specific type of disadvantaged regions.

The findings presented in this paper remain a first exploration of sub-provincial disparities in Canada. Further research could extend the analysis in several directions. Specifically, disparity trends could be evaluated by using a set of alternative income concepts, such as average versus median income, total versus market income and before and after tax income. Further analysis could also consider the contribution of various income components, such as wages and salaries, self-employment, and government transfers to income disparity trends. The available data would also allow a better understanding of the contribution of population changes to income disparity trends in a more detailed geographic scale. Finally, a similar assessment of territorial disparity could be extended to indicators other than income, and among these in particular unemployment indicators.

References

Afxentiou, Panos C., and Apostolos Serletis. 1998. Convergence Across Canadian Provinces. *Canadian Journal of Regional Science* XXI(1):111-126.

Barro, R. J. and X. Sala-i-Martin. 1992. Convergence. *Journal of Political Economy*. 100(2):223-251.

Chatterji, M., and J.H.L. Dewhurst. 1997. Convergence Clubs and Relative Economic Performance in Great Britain: 1977-1991. *Regional Studies* 30(1):31-40.

Coffey, William J., and Mario Polèse. 1988. Locational shifts in Canadian employment, 1971-1981: Decentralization v. Decongestion. *The Canadian Geographer* 32(3):248-256.

Coulombe, Serge. 2000. New Evidence of Convergence Across Canadian Provinces: The Role of Urbanization. *Regional Studies* 34(8):713-725.

Coulombe, Serge. 1999. *Economic Growth and Provincial Disparity: A New View of an Old Canadian Problem*. C.D. Howe Institute Commentary. No 122.

Coulombe, Serge, and Jean-François Tremblay. 2001. Human capital and regional convergence in Canada. *Journal of Economic Studies* 28(3):154-180.

Coulombe, S., and F.C. Lee. 1993. *Regional Economic Disparities in Canada*. University of Ottawa working paper 9317E. Ottawa.

Esteban, J., and D. Ray. 1994. On the measurement of polarization. *Econometrica* 62:819-851.

Foster, J. E., and M. C. Wolfson. 1992. *Polarization and the Decline of the Middle Class: Canada and the U.S.* (Manuscript).

Gastwirth, Joseph L. 1972. The estimation of the Lorenz Curve and Gini Index. *Rev. of Economics and Statistics* 54:306-216.

Hofer, Helmut, and Andreas Worgotter. 1997. Regional Per Capita Income Convergence in Austria. *Regional Studies, Regional Studies Association* 31(1):1-12.

Johnston, Paul A. 2000. A nonparametric analysis of income convergence across the US states. *Economic letters* 69(2):219-223.

Joseph, Alun E., and Phil D. Keddie. 1988. Unravelling the population turnaround in rural Canada. *The Canadian Geographer* 32(1):17-30.

Kangasharju, Aki. 1999. Relative Economic Performance in Finland: Regional Convergence, 1934-1993. *Regional Studies, Regional Studies Association* 33(3):207-217.

Keddie, Phil, and Alun E. Joseph. 1991. The turnaround of the turnaround? Rural population change in Canada, 1976 to 1986. *The Canadian Geographer* 35(4):367-379.

Kovacevic, Milorad, and David A. Binder. 1997. Variance Estimation for Measures of Income Inequality and Polarization. The Estimating Equations Approach. *Journal of Official Statistics* 13(1):41-58.

Krugman, P. 1991. *Geography and Trade*. London: MIT Press.

Lopez-Bazo, Enrique, Esther Vaya, Antonio J. Mora, and Jordi Surinach. 1999. Regional economic dynamics and convergence in the European Union. *Annals of Regional Science* 33:343-370.

Lefebvre, Mario. 1994. *Les provinces canadiennes et la convergence: une évaluation empirique*. Working Paper 94 10. Bank of Canada. Ottawa.

Maxwell, Philip. 1994. Trends in Regional Income Disparities: An Australian Perspective on the Canadian Experience. *Canadian Journal of Regional Science* XVII(2):189-215.

Moazzami, Bakhtiar.1997. Regional Wage Convergence in Canada: An Error-Correction Approach. *The Canadian Journal of Regional Science* 20(3):341-350.

Myles, J., Picot G., and Pyper W. 2000. Neighbourhood Inequality in Canadian Cities. Catalogue no. 11F0019MIE, Working Paper 160. Statistics Canada. Ottawa.

OECD. 2001. *Territorial Outlook 2001*. Paris: OECD.

Petrakos, George, and Yiannis Saratsis. 2000. Regional inequalities in Greece. *Papers in Regional Science,* 79(1):57-74.

Quah, Danny. 1993. Empirical cross-section dynamics in economic growth. *European Economic Review* 37:426-434.

Quah, Danny T. 1996a. Regional convergence clusters across Europe. *European Economic Review* 40:951-958.

Quah, Danny T. 1996b. Empirics for economic growth and convergence. *European Economic Review* 40:1353-1375.

Rey, Sergio J. 2001. *Spatial Dependence in the Evolution of Regional Income Distributions*. Paper Presented to the Applied Econometric Association/ Western Regional Science Association Conference - Palm Spring, California.

Rey, Sergio J. and Brett D. Montouri. 1999. US Regional Income Convergence: A Spatial Econometric Perspective. *Regional Studies, Regional Studies Association* 33(3):143-156.

Sala-i-Martin, Xavier X. 1996. Regional cohesion: Evidence and theories of regional growth and convergence. *European Economic Review* 40:1325-1352.

Sanga, Dimitri. 2000. Income inequality within provinces. *Perspectives on Labour and Income*, Winter 2000:33-38. Catalogue no. 75-001-XPF, 12(4):35-40. Statistics Canada. Ottawa.

Shearmur, Richard, and Mario Polèse. 2001. *Economic Development in Canadian Peripheral Regions, 1971 to 1996. A Statistical Overview*. Research report. INRS. Montreal.

Statistics Canada. 2001. *Neighbourhood Income and Demographics – User's Guide*. Small Area and Administrative Data Division. Statistics Canada. Ottawa.

Theil, H. 1967. *Economics and Information Theory*. Chicago: Rand McNally and Company.

Thisse, Jacques-Francois. 1993. Oligopoly and the polarization of space. *European Economic Review* 37:299-307.

Williamson, J. 1965. Regional Inequality and the Process of National Development: A Description of Patterns. *Economic Development and Cultural Change* 13(4):3-45.

Wolfson, Michael C. 1989. *Inequality and Polarization: It There a Disappearing Middle Class in Canada?* Proceedings of the Statistics Canada Symposium on Analysis of Data in Time. 1989.

Wolfson, Michael C., and Brian B. Murphy. 1998. *New Views on Inequality Trends in Canada and the United States*. Catalogue no. 11F0019MIE, Working Paper No. 124. Statistics Canada. Ottawa.

Appendix A

Table A.1. Summary table of measures and statistics

Index/ indicator	1992	1993	1994	1995	1996	1997	1998	1999
Average income ($1995)	25,837	24,971	25,602	25,773	25,863	26,234	26,947	27,310
Weighted indices of dispersion of average income[1]								
Coefficient of variation	15.000	14.603	13.807	13.708	14.207	15.023	15.857	15.956
Variance of logarithm	0.465	0.441	0.394	0.388	0.420	0.463	0.510	0.506
Gini coefficient	8.450	8.192	7.679	7.605	7.873	8.314	8.820	8.895
Theil's index (total)	0.499	0.473	0.422	0.416	0.448	0.497	0.552	0.555
Unweighted indices of average income [1]								
Coefficient of variation	20.311	19.894	19.211	19.120	19.895	20.600	21.277	20.949
Variance of logarithm	1.078	1.032	0.965	0.963	1.051	1.133	1.212	1.143
Theil decomposition[1] (average income)								
Between provinces	0.244	0.230	0.194	0.184	0.197	0.222	0.249	0.249
Within provinces	0.254	0.243	0.228	0.232	0.251	0.275	0.303	0.306
Between as % of total	49.00	48.56	45.95	44.29	43.98	44.72	45.03	44.87
Within as % of total	51.00	51.44	54.05	55.71	56.02	55.28	54.97	55.13
Between OECD types[2]	0.184	0.169	0.157	0.156	0.168	0.183	0.209	0.209
Within OECD types	0.315	0.304	0.265	0.260	0.279	0.314	0.343	0.346
Between as % of total	36.79	35.74	37.19	37.56	37.64	36.85	37.93	37.67
Within as % of total	63.21	64.26	62.81	62.44	62.36	63.15	62.07	62.33
Between StatCan types[2]	0.185	0.171	0.161	0.160	0.172	0.185	0.210	0.213
Within StatCan types	0.314	0.302	0.261	0.256	0.276	0.313	0.342	0.343
Between as % of total	37.06	36.13	38.19	38.56	38.44	37.10	38.07	38.28
Within as % of total	62.94	63.87	61.81	61.44	61.56	62.90	61.93	61.72
Provincial weighted indices of dispersion of average income[1]								
Coefficient of variation	10.507	10.179	9.359	9.124	9.413	9.999	10.588	10.615
Variance of logarithm	0.222	0.209	0.177	0.167	0.180	0.204	0.227	0.226
Concentration: indices of dispersion of aggregate income [1]								
Coefficient of variation	2.567	2.552	2.533	2.537	2.564	2.582	2.603	2.614
Variance of logarithm	0.429	0.429	0.427	0.429	0.431	0.442	0.450	0.453
Theil's index	0.500	0.498	0.494	0.495	0.500	0.507	0.513	0.517
Concentration: Percentage of national aggregate income of:								
Top 5 CDs	29.45	29.37	29.09	29.22	29.71	30.03	30.25	30.27
Top 10 CDs	42.43	42.37	42.05	42.06	42.47	42.97	43.46	43.72
Top 20 CDs	57.03	56.93	56.74	56.82	57.16	57.63	58.16	58.53
Top 30 CDs	64.82	64.66	64.46	64.55	64.81	65.19	65.64	65.95
Top 50 CDs	73.31	73.22	73.06	73.13	73.31	73.62	74.03	74.26
Top 100 CDs	85.94	85.94	85.85	85.86	85.90	86.12	86.35	86.49
Bottom 5 CDs	0.08	0.08	0.08	0.08	0.09	0.08	0.07	0.08
Bottom 10 CDs	0.21	0.21	0.20	0.20	0.21	0.20	0.19	0.19
Bottom 20 CDs	0.52	0.52	0.51	0.51	0.51	0.49	0.48	0.48
Bottom 30 CDs	0.90	0.90	0.90	0.89	0.88	0.85	0.83	0.82
Bottom 50 CDs	1.86	1.86	1.87	1.86	1.83	1.77	1.74	1.72
Bottom 100 CDs	5.05	5.03	5.05	5.04	4.97	4.85	4.76	4.72

(continued)

Table A.1. Summary table of measures and statistics (continued)

Index/ indicator	1992	1993	1994	1995	1996	1997	1998	1999
Concentration: Percent aggregate income by CD regional types								
Predominantly urban	53.46	53.41	53.24	53.21	53.5	53.8	54.13	54.22
Intermediate	20.10	20.05	20.18	20.26	20.15	20.13	20.16	20.31
Rural metro-adjacent	14.00	14.09	14.15	14.13	14.15	14.08	14.01	13.94
Rural non-metro-adjacent	10.75	10.77	10.78	10.75	10.61	10.45	10.20	10.01
Rural northern regions	1.69	1.67	1.65	1.65	1.59	1.55	1.5	1.52

Note: (1) the original values of the indices are multiplied by 100 for convenience of display.
(2) The "OECD regional types" refer to three groups of census divisions: predominantly urban; intermediate; and predominantly rural. The "Statistics Canada regional types" refer to four groups of census divisions: an urban group comprised of predominantly urban and intermediate census divisions plus three predominantly rural groups (rural metro-adjacent, rural non-metro-adjacent and rural northern census divisions).

Source: Calculations based on Small Area and Administrative Data, Statistics Canada.

Appendix B: Definition of total income

The definition of *Total income* in the SAAD database was revised over the years. All income amounts are gross, with the exception of net rental income, net limited partnership income and all forms of net self-employment income. The following items are included in our measure of total income for the years specified (See Statistics Canada, 2001 for further details):

- Old Age Security/Net Federal Supplements (the latter including guaranteed income supplements and spouses' allowances since 1994)
- (Federal) Family Allowance benefits (up to and including 1992)
- Quebec family allowance (beginning with 1994)
- British Columbia family bonus (beginning with 1996)
- New Brunswick child benefit supplement (beginning with 1997)
- Alberta family employment tax credit (beginning with 1997)
- Northwest Territories child benefit (beginning with 1998)
- Nova Scotia child tax benefit (beginning with 1998)
- Nunavut child benefit (beginning with 1998)
- Ontario child care supplement for working families (beginning with 1998)
- Saskatchewan child benefit (beginning with 1998)
- RRSP income (since 1994; previously in "other income")
- Harmonized Sales Tax (HST) credit (beginning in 1997)
- Child tax credit (up to and including 1992)
- Canada Child Tax Benefit (starting with 1993)
- Workers' compensation payments (shown separately starting with 1994)
- Social assistance payments (shown separately starting with 1994)
- Guaranteed income supplements (included with Net Federal Supplements since 1994; previously in "non-taxable income")
- Spouses' allowances (included with Net Federal Supplements since 1994; previously in "non-taxable income")
- Provincial refundable tax credits in Ontario, Quebec and Manitoba (since 1990), British Columbia and the Northwest Territories (since 1993), Newfoundland and Nunavut (since 1997).

Appendix C: Mathematical specification of the indices

The specification of the indices used in analysis is presented below. For all the equations y is the average per capita income, Y indicates the aggregate income, Pop is the population, i is the subscript for the ith territorial unit, r indicates the rth aggregate of territorial units (e.g. a province). The superscript '*' indicates national values, the superscript "cs" indicates cumulative shares.

Coefficient of variation, weighted (CV_w) and unweighted (CV_u)

$$CV_w = \frac{\sqrt{\sum_{i=1}^{N} \frac{Pop_i}{Pop^*} (y_i - y^*)^2}}{y^*} \qquad CV_u = \frac{\sqrt{\sum_{i=1}^{N} \frac{1}{N} (y_i - y^*)^2}}{y^*}$$

Variance of logarithms, weighted (VL_w) and unweighted (VL_u)

$$VL_w = \sum_{i=1}^{N} \frac{Pop_i}{Pop^*} \cdot \left(\log \frac{y_i}{y^*} \right)^2 \qquad VL_u = \sum_{i=1}^{N} \frac{1}{N} \cdot \left(\log \frac{y_i}{y^*} \right)^2$$

Gini coefficient

$$GINI = 1 - \sum_{i=1}^{N} \left[\left(y_i^{cs} + y_{i-1}^{cs} \right) \cdot \left(Pop_i^{cs} - Pop_{i-1}^{cs} \right) \right]$$

Theil's index: total (T_{tot}) and aggregate (T_{agg}) income

$$T_{tot} = \sum_{i=1}^{N} \frac{Y_i}{Y^*} \log \left(\frac{Y_i / Y^*}{Pop_i / Pop^*} \right) \qquad T_{agg} = \sum_{i=1}^{N} \frac{Y_i}{Y^*} \log \left(\frac{Y_i / Y^*}{1/N} \right)$$

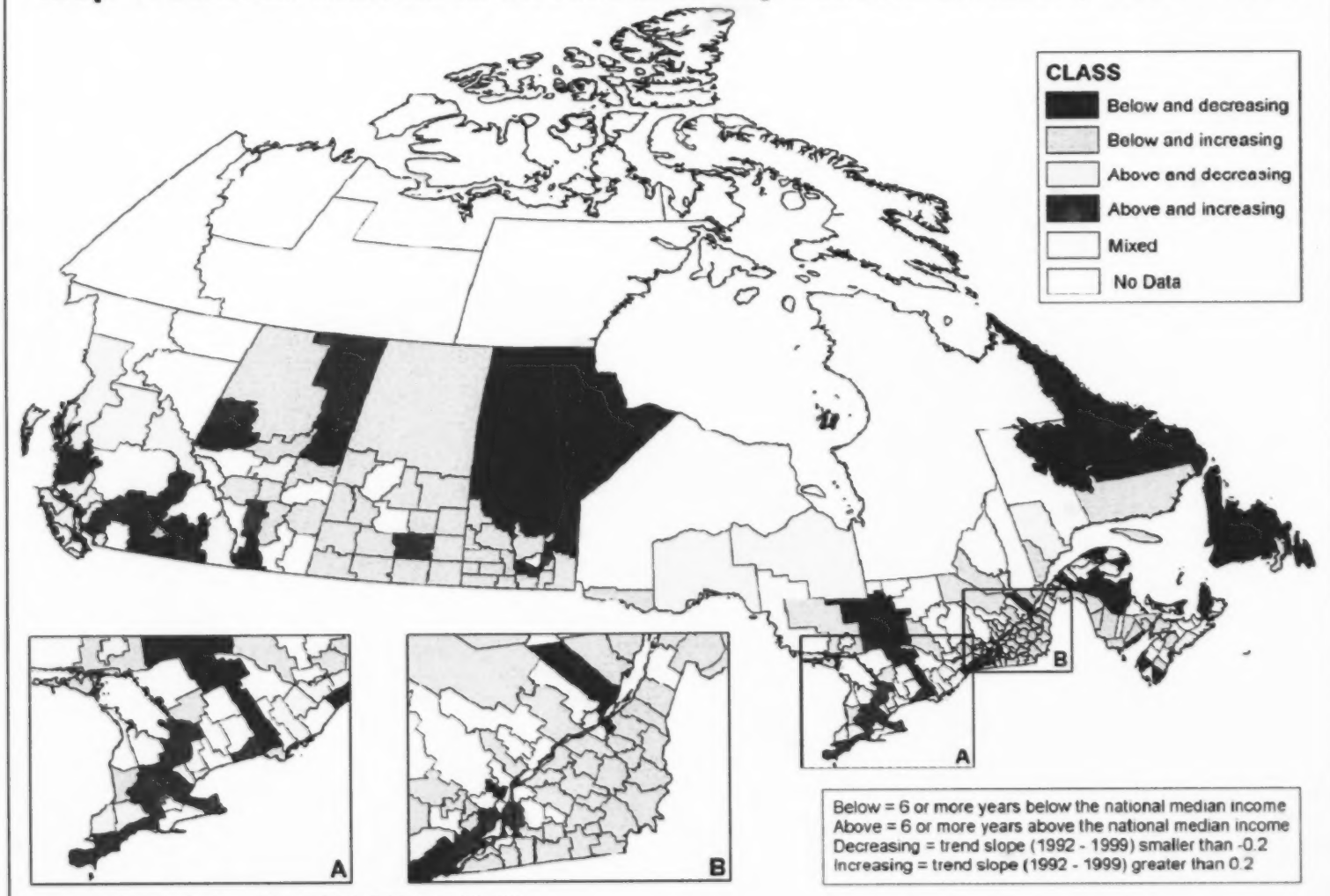
Decomposition of Theil's index: between (T_{bg}) and within (T_{wg}) group inequality

$$T_{tot} = T_{bg} + T_{wg}$$

$$T_{bg} = \sum_{r} \frac{Y_r}{Y^*} \log \frac{Y_r \; Y^*}{Pop_r \; Pop^*}$$

$$T_{wg} = \sum_{r} \frac{Y_r}{Y^*} \left[\sum_{i \in r} \frac{Y_i}{Y_r} \log \frac{Y_i \; Y_r}{Pop_i \; Pop_r} \right]$$

Map 1: Median income level and trend by census division, 1992 - 1999


CLASS
Below and decreasing
Below and increasing
Above and decreasing
Above and increasing
Mixed
No Data
A
B
A
B
Below = 6 or more years below the national median income
Above = 6 or more years above the national median income
Decreasing = trend slope (1992 - 1999) smaller than -0.2
Increasing = trend slope (1992 - 1999) greater than 0.2

Source: Computation based on Small Area and Administrative Data, Statistics Canada, 1992 - 1999
Map produced by Spatial Analysis and Geomatics Applications (SAGA), Agriculture Division, Statistics Canada, 2002

Agriculture and Rural Working Paper Series

(* The *Agriculture and Rural Working Paper Series* is now available on Statistics Canada's Web Site (www.statcan.ca). From the *Our products and services* page, under *Browse our Internet publications (PDF or HTML)*, choose *Free*, then *Agriculture*.)

No.1	(21-601-MPE1980001)	**A Description of Theil's RMPSE Method in Agricultural Statistical Forecasts (1980)**, Stuart Pursey
No.3	(21-601-MPE1981003)	**A Review of the Livestock Estimating Project with Recommendations for the Future (1981)**, Bernard Rosien and Elizabeth Leckie
No.4	(21-601-MPE1984004)	**An Overview of the Canadian Oilseed Industry (1984)**, Glenn Lennox
No.5	(21-601-MPE1984005)	**Preliminary Analysis of the Contribution of Direct Government Payments to Realized Net Farm Income (1984)**, Lambert Gauthier
No.6	(21-601-MPE1984006)	**Characteristics of Farm Entrants and their Enterprises in Southern Ontario for the Years 1966 to 1976 (1984)**, Jean B. Down
No.7	(21-601-MPE1984007)	**A Summary of Commodity Programs in the United States (1984)**, Allister Hickson
No.8	(21-601-MPE1984008)	**Prairie Summerfallow Intensity: An Analysis of 1981 Census Data (1984)**, Les Macartney
No.9	(21-601-MPE1985009)	**The Changing Profile of the Canadian Pig Sector (1985)**, Mike Shumsky
No.10	(21-601-MPE1986010)	**Revisions to the Treatment of Imputed House Rents in the Canadian Farm Accounts, 1926-1979 (1986)**, Mike Trant
No.11	(21-601-MPE1992011)	**The Ratio Estimator: an Intuitive Explanation and Its Use in Estimating Agriculture Variables (1992)**, François maranda and Stuart Pursey
No.12	(21-601-MPE1991012)	**The Impact of Geographic Distortion Due to the Headquarters Rule (1991)**, Rick Burroughs
No.13	(21-601-MPE1991013)	**The Quality of Agriculture Data - Strengths and Weaknesses (1991)**, Stuart Pursey
No.14	(21-601-MPE1992014)	**Alternative Frameworks for Rural Data (1992)**, A.M. Fuller, Derek Cook and Dr. John Fitzsimons
No.15	(21-601-MPE1993015)	**Trends and Characteristics of Rural and Small Town Canada (1993)**, Brian Bigs, Ray Bollman and Michael McNames
No.16	(21-601-MPE1992016)	**The Microdynamics and Farm Family Economics of Structural Change in Agriculture (1992)**, Phil Ehrensaft and Ray Bollman
No.17	(21-601-MPE1993017)	**Grains and Oilseeds Consumption by Livestock and Poultry, Canada and Provinces 1992**, Livestock and Animal Products Section
No.18	(21-601-MPE1994018)	**Trends and Patterns of Agricultural Structural Change: Canada / US Comparison**, Ray Bollman, Leslie A. Whitener and Fu Lai Tung
No.19	(21-601-MPE1994019)	**Farm Family Total Income by Farm Type, Region and Size for 1990 (1994)**, Saiyed Rizvi, David Culver, Lina Di Piétro and Kim O'Connor
No.20	(21-601-MPE1991020)	**Adjustment in Canadian Agriculture (1994)**, George McLaughlin
No.21	(21-601-MPE1993021)	**Microdynamics of Farm Size Growth and Decline: A Canada-United States Comparison**, Fred Gale and Stuart Pursey
No.22	(21-601-MPE1992022)	**The Structures of Agricultural Household Earnings in North America: Positioning for Trade Liberalization**, Leonard Apedaile, Charles Barnard, Ray Bollman and Blaine Calkins
No.23	(21-601-MPE1992023)	**Potatoes: A Comparison of Canada/USA Structure**, Glenn Zepp, Charles Plummer and Barbara McLaughlin
No.24	(21-601-MPE1994024)	**Farm Structure Data: A US-Canadian Comparative Review**, Victor J. Oliveira, Leslie A. Whitener and Ray Bollman
No.25	(21-601-MPE1994025)	**Grain Marketing Statistics Statistical Methods Working Paper Version 2**, Karen Gray

Agriculture and Rural Working Paper Series (continued)

(* The *Agriculture and Rural Working Paper Series* is now available on Statistics Canada's Web Site (www.statcan.ca). From the *Our products and services* page, under *Browse our Internet publications (PDF or HTML)*, choose *Free*, then *Agriculture*.)

No.26	(21-601-MPE1994026)	**Farm Business Performance: Estimates from the Whole Farm Database**, W. Steven Danford
No.27	(21-601-MPE1994027)	**An Attempt to Measure Rural Tourism Employment**, Brian Biggs
No.28*	(21-601-MIE1995028)	**Delineation of the Canadian Agricultural Ecumene for 1991**, Timothy J. Werschler
No.29	(21-601-MPE1995029)	**Mapping the Diversity of Rural Economies: A preliminary Typology of Rural Canada**, Liz Hawkins
No.30*	(21-601-MIE1996030)	**Structure and Trends of Rural Employment: Canada in the Ciontext of OECD Countries**, Ron Cunningham and Ray D. Bollman
No.31*	(21-601-MIE1996031)	**A New Approach to Non-CMA/CA Areas**, Linda Howatson-Leo and Louise Earl
No.32	(21-601-MPE1996032)	**Employment in Agriculture and Closely Related Industries in Rural Areas: Structure and Change 1981-1991**, Sylvain Cloutier
No.33*	(21-601-MIE1998033)	**Hobby Farming - For Pleasure or Profit?**, Stephen Boyd
No.34*	(21-601-MIE1998034)	**Utilization of Document Imaging Technology by the 1996 Canadian Census of Agriculture**, Mel Jones and Ivan Green
No.35*	(21-601-MIE1998035)	**Employment Patterns in the Non-Metro Workforce**, Robert Mendelson
No.36*	(21-601-MIE1998036)	**Rural and Small Town Population is Growing in the 1990s**, Robert Mendelson and Ray D. Bollman
No.37*	(21-601-MIE1998037)	**The Composition of Business Establishments in Smaller and Larger Communities in Canada**, Robert Mendelson
No.38*	(21-601-MIE1998038)	**Off-farm Work by Census-farm Operators: An Overview of Structure and Mobility Patterns**, Michael Swidinsky, Wayne Howard and Alfons Weersink
No.39*	(21-601-MIE1999039)	**Human Capital and Rural Development: What Are the Linkages?**, Ray D. Bollman
No.40*	(21-601-MIE1999040)	**Computer Use and Internet Use by Members of Rural Households**, Margaret Thompson-James
No.41*	(21-601-MIE1999041)	**RRSP Contributions by Canadian Farm Producers in 1994**, Marco Morin
No.42*	(21-601-MIE1999042)	**Integration of Administrative Data with Survey and Census Data**, Michael Trant and Patricia Whitridge
No.43*	(21-601-MIE2001043)	**The Dynamics of Income and Employment in Rural Canada: The Risk of Poverty and Exclusion**, Esperanza Vera-Toscano, Euan Phimister and Alfons Weersink
No.44*	(21-601-MIE2001044)	**Rural Youth Migration Between 1971 and 1996**, Juno Tremblay
No.45*	(21-601-MIE2001045)	**Measuring Economic Well-Being of Rural Canadians Using Income Indicators**, Carlo Rupnik, Margaret Thompson-James and Ray D. Bollman
No.46*	(21-601-MIE2001046)	**The Geographical Patterns of Socio-Economic Well-Being of First Nations Communities in Canada**, Robin P. Armstrong
No.47*	(21-601-MIE2001047)	**Distribution and Concentration of Canadian Livestock**, Martin S. Beaulieu
No.48*	(21-601-MIE2001048)	**Intensive Livestock Farming: Does Farm Size Matter?**, Martin S. Beaulieu
No.49*	(21-601-MIE2001049)	**Agriculture Statistics for Rural Development**, Ray D. Bollman
No.50*	(21-601-MIE2001050)	**Rural and Small Town Employment: Structure by Industry**, Roland Beshiri and Ray D. Bollman

Agriculture and Rural Working Paper Series (continued)

(* The *Agriculture and Rural Working Paper Series* is now available on Statistics Canada's Web Site (www.statcan.ca). From the *Our products and services* page, under *Browse our Internet publications (PDF or HTML)*, choose *Free*, then *Agriculture*.)

No.51*	(21-601-MIE2001051)	**Working Time: How do Farmers Juggle with it and How has it Impacted Their Farmily Total Income**, Sylvain Cloutier
No.52*	(21-601-MIE2001052)	**Growers of Genetically Modified Grain Corn and Soybeans in Quebec and Ontario: A Profile**, Bernard Hategekimana
No.53*	(21-601-MIE2002053)	**Integration of Canadian and U.S. Cattle Markets**, Rita Athwal
No.54*	(21-601-MIE2002054)	**Genetically Modified Grain Corn and Soybeans in Quebec and Ontario in 2000 and 2001,** Bernard Hategekimana
No.55*	(21-601-MIE2002055)	**Recent Migration Patterns in Rural and Small Town Canada,** Neil Rothwell et al
No.56*	(21-601-MIE2002056)	**Performance in the Food Retailing Segment of the Agri-Food Chain**, David Smith and Michael Trant
No.57*	(21-601-MIE2002057)	**Financial Characteristics of Acquired Firms in the Canadian Food Industry**, Martin S. Beaulieu
No.58*	(21-601-MIE2002058)	**Provincial Trade Patterns**, Marjorie Page
No.59*	(21-601-MIE2002059)	**An Analysis of Profits within the Canadian Food Processing Sector**, Rick Burroughs and Deborah Harper
No.60*	(21-601-MIE2002060)	**Rural Diversification**, Marjorie L. Page
No.61*	(21-601-MIE2002061)	**Definitions of « Rural »**, Valerie du Plessie et al
No.62*	(21-601-MIE2003062)	**A Geographic Profile of Canadian Livestock**, Martin S. Beaulieu et Frédéric Bédard